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ABSTRACT

Opportunities for utilizing large-scale educational telecommunications delivery systems to aid in meeting needs of U.S. education are extensively analyzed in a NASA-funded report. Status, trends, and issues in various educational subsectors are assessed, along with current use of telecommunications and technology and factors working for and against expanded utilization. Opportunities for future use of large-scale telecommunications systems for each subsector are forecast and identified. Subsectors assessed are elementary and secondary education, higher education, vocational technical and career, adult education, continuing professional education, early childhood, education for the handicapped, aged, and institutionalized. Public broadcasting, instructional television, computer-assisted instruction, computer-resource sharing, and information resource sharing are explored for possible use. Policy implications of large-scale use of technology are identified and considered. A bibliography of pertinent documents is appended. (SK)

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WASHINGTON UNIVERSITY

CENTER FOR DEVELOPMENT TECHNOLOGY

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LARGE-SCALE EDUCATIONAL TELECOMMUNICATIONS SYSTEMS FOR THE U. S.:

AN ANALYSIS OF EDUCATIONAL NEEDS AND TECHNOLOGICAL OPPORTUNITIES

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CENTER FOR DEVELOPMENT TECHNOLOGY

WASHINGTON UNIVERSITY
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Memorandum No. CG-75/1

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April, 1975

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While freely recognizing the contributions of and our debt to others, the responsibility for the contents of the report, its accuracy and its wisdom (or lack thereof!) rests with the authors.

GUIDE TO THE BUSY READER

We have not prepared an Executive Summary as is sometimes customary in reports of this kind. In addition to the familiar excuse that a report of this magnitude and dimension is almost impossible to summarize accurately, we feel it much preferable that the report be read in its entirety.

For those whose time is limited, we suggest reading Chapter I, Introduction: Purpose and Overview of Report and Chapter V, Summary Analysis and Conclusions. Taken together, these two chapters provide the equivalent of an Executive Summary.

We plan to issue a guide to all the reports we have prepared in connection with our project on Application of Communications Satellites to Educational Development in a final project report to NASA in August, 1975.

LARGE-SCALE EDUCATIONAL TELECOMMUNICATIONS
SYSTEMS FOR THE U. S.: AN
ANALYSIS OF EDUCATIONAL NEEDS AND TECHNOLOGICAL OPPORTUNITIES

I. INTRODUCTION: PURPOSE AND OVERVIEW OF REPORT

The purpose of this document is to set forth possible opportunities for utilizing large-scale educational telecommunications delivery systems to aid in meeting needs of U. S. education. We do not imply by the word "needs" that the need for such a large-scale delivery system has been established in this report. The word is used more in the sense that the individuals who make up the diverse educational community and the larger society of which it is a part are faced with a variety of circumstances and conditions which give rise to a set of needs or demands. From these needs or demands arise opportunities for employing large-scale telecommunications systems as one of many responses to the continually changing educational scene.

The approach we have taken in this study is to examine in considerable detail the status of, and trends and issues in a variety of educational sub-sectors. We have investigated current uses of technology and telecommunications in these sub-sectors, analyzing factors working for and against expanded utilization. We have sought to forecast and identify opportunities for future use of large-scale telecommunications systems in education. Wherever possible, we have focussed upon the potential role of communications satellites in a large-scale delivery system.

This document draws heavily upon the results of a variety of studies carried out in the Washington University Program on Application of Communication Satellites to Educational Development. A primary objective of this NASA-sponsored, interdisciplinary research program has been to define alternative educational telecommunications systems employing communications satellites to aid in improving U. S. education. This document brings together results of the "Needs Analysis" phase of this research program, which is concerned with providing as firm a foundation as possible for synthesizing hypothetical educational satellite systems. It is believed that the report will also serve to provide useful information and analyses for educational planners, policy-makers and citizens who may be faced with decisions concerning the future role of large-scale telecommunications systems in education.

Taken as a whole, the report constitutes a planning document for what might be described as an educational telecommunications delivery system which is national in scope. We have attempted to describe the educational underpinnings for such a system -- the needs to be served, the sub-sectors in which the system might be used, the kinds of technologies which might be employed and the prospects for future utilization. Specific market scenarios, channel requirements and alternative administrative frameworks for such a system are developed in a companion report.[1] Work is also proceeding on an analysis of the potential long-term socio-economic impacts, both good and bad, of such a system upon education and society.

The rationale for looking broadly at possible markets and services is that satellite utilization requires economies of scale to get per user costs down to reasonable levels. Although not all educational sub-sectors may lend themselves equally well to technology utilization, a broad examination of both educational sub-sectors and technology-based educational services, including those services useful for administration and resource sharing, as well as for instruction and research, is more likely to identify possible opportunities for satellite utilization than a more limited view. Until now, the only viable markets for satellites have been for commercial telecommunications traffic. By pooling opportunities in various sub-sectors, it is possible that a potential market for a dedicated educational satellite system* or for educational channels on a commercial system may be found to exist which in turn may spur the development of more imaginative systems for satellite utilization in education than has been the case in the past.

The difficulties inherent in performing the type of analysis contained in this report and the accompanying document[1] should be appreciated at the outset. Ofttimes, in the language of systems analysis, the "user" defines his needs or requirements in terms which are specific enough, e.g., channel capacity, number and location of delivery points, etc., so that the systems designer can proceed to lay out the system. However, in the field of education, no two people may agree on what is really needed. Use of educational technology and telecommunications is currently at a relatively low level. Furthermore, there seems to be little concern with or clamor for educational technology on the part of many people involved in education. "Users" becomes a difficult term to define (teachers? students? principals? educational associations?) let alone to lump in a convenient term like "educational community."

Thus, this report provides only limited information of the type and specificity required by the systems designer. However, a careful reading of the report should provide insight into opportunities and "markets"** for educational telecommunications systems which can then be translated into more specific requirements. We hope that the report will serve as a bridge between the technologist seeking to gain understanding of educational needs and the "educationalist" who wishes to gain insight into the possibilities and problems inherent in using educational technology and telecommunications.

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*That is, one devoted solely to educational uses.

**The word "market" is used in this report in the sense that there are social markets to be served in education, and not in the normal business sense. However, the question of who will pay for educational telecommunications services is clearly of concern.

The analyses of educational sub-sectors presented in this document are our own perceptions, based upon an extensive series of studies carried out by our research group over the past four years.[2-19A] We have tried, wherever possible, to maintain contact with current or potential users of educational technology. Although there is no guarantee in a field as complex as education that any proposed large-scale educational telecommunications system will ever gain acceptance, it is believed that the approach taken is preferable to one in which the systems design is carried out with little real insight into the nature of the educational enterprise. The difficult design decisions are likely to rest upon political and organizational issues as opposed to purely technological ones.

To our knowledge, there are few studies available which parallel this one. A paper by Curtis[20] presented at a 1973 Conference on Frontiers in Education outlines a plan for a national educational telecommunications network. The Curtis paper considers many of the same issues as are contained in this report but its many statements, estimates and recommendations are unsupported by extensive analysis, documentation, and references. A recent report on Technology Requirements for Post-1985 Communications Satellites[21] contains a "Needs Model" section based in part upon prior work reported by our research group. Some limited studies seeking to define markets for educational satellites services have been performed by the Office of Telecommunications Policy of the Department of Health Education and Welfare.(83, 84, 85, 305)

This report is divided into three main sections. Chapter II focuses upon various educational subsectors, e.g., primary and secondary education, early childhood education, etc. Emphasis is placed upon the current status and trends within each sub-sector, issues which might affect future development, and prospects for future use of media, technology and large-scale electronic delivery within each sub-sector. This Chapter, which contains a major portion of the information and analyses found in this report, gives primary attention to the various educational subsectors but develops information on technology utilization in considerable detail where appropriate. For example, the section on higher education contains a description of current and planned experiments involving the use of communications satellites in that subsector.

In Chapter III, various educational telecommunications services are identified. Services are grouped into five categories, namely, public television and radio, instructional television, computer-aided instruction, computer resource sharing and information resource sharing. Here, instead of focusing upon a particular educational subsector, the emphasis is upon the technology-based services, their current utilization and factors which might affect future development. The role of communications satellites in providing these services is discussed. Although there may be some overlap with the previous chapter, it was felt that emphasizing services would be of particular value to potential users within education.

Chapter IV summarizes previous efforts, including those of our research group, to analyze and estimate future utilization of large-scale educational telecommunications, including estimates of future satellite use. Emphasis is placed upon a recent Delphi forecast of technology in education by Robinson[18] of our research team. Factors which might affect future utilization are identified.

A Final Chapter provides an overall analysis and presents major conclusions to be drawn from this study.

II. ANALYSIS OF EDUCATIONAL SUBSECTORS: STATUS, TRENDS, ISSUES AND PROSPECTS FOR ELECTRONIC DELIVERY

A. INTRODUCTION: DEFINITION OF EDUCATIONAL SUBSECTORS

There exists a substantial number of educational subsectors, which individually or in the aggregate may be perceived as potential markets for services provided by an educational telecommunications system. These sub-sectors range from elementary and secondary education to higher education, from early childhood education to adult education, from education for migrants to continuing professional education. When defined in this manner, the potential market for educational telecommunications in the U. S. is essentially bounded at the upper limit by the total population of the United States; more than 200 million people. Furthermore, the process of education is not necessarily limited to formal schooling and we in turn have not limited our definition of education to that which occurs in a formal school setting.

Even if one were to limit the focus of this study to formal education, the size of the formal educational establishment alone is staggering. According to a report by the National Center for Educational Statistics[22]:

"Education is today the major occupation of 62.8 million people in the United States. That figure, along with the fact that more than $90 billion will be spent by educational institutions this year,* lends credence to the contention that education is now the Nation's largest enterprise. Included in the 62.8 million total are 59.5 million students enrolled in our schools and colleges, 3 million teachers and about 300,000 superintendents, principals, supervisors, and other instructional staff members.

---

*1972-1973

This means that in a nation with 209 million people about 3 out of every 10 persons are directly involved in the educational process."

The structure of formal education in the U. S. is illustrated by Figure 1. Total expenditures for education in 1971 amounted to close to 8 per cent of the Gross National Product.[22] If one uses the expanded definition of education employed in this report, and includes the efforts of individuals not directly involved in the instructional process, the extent of personal and financial involvement in the total educational sector becomes even more imposing.

Table 1 lists the various educational sub-sectors which will be considered in turn in the following pages. Briefly, they include:

1. Elementary and Secondary Education

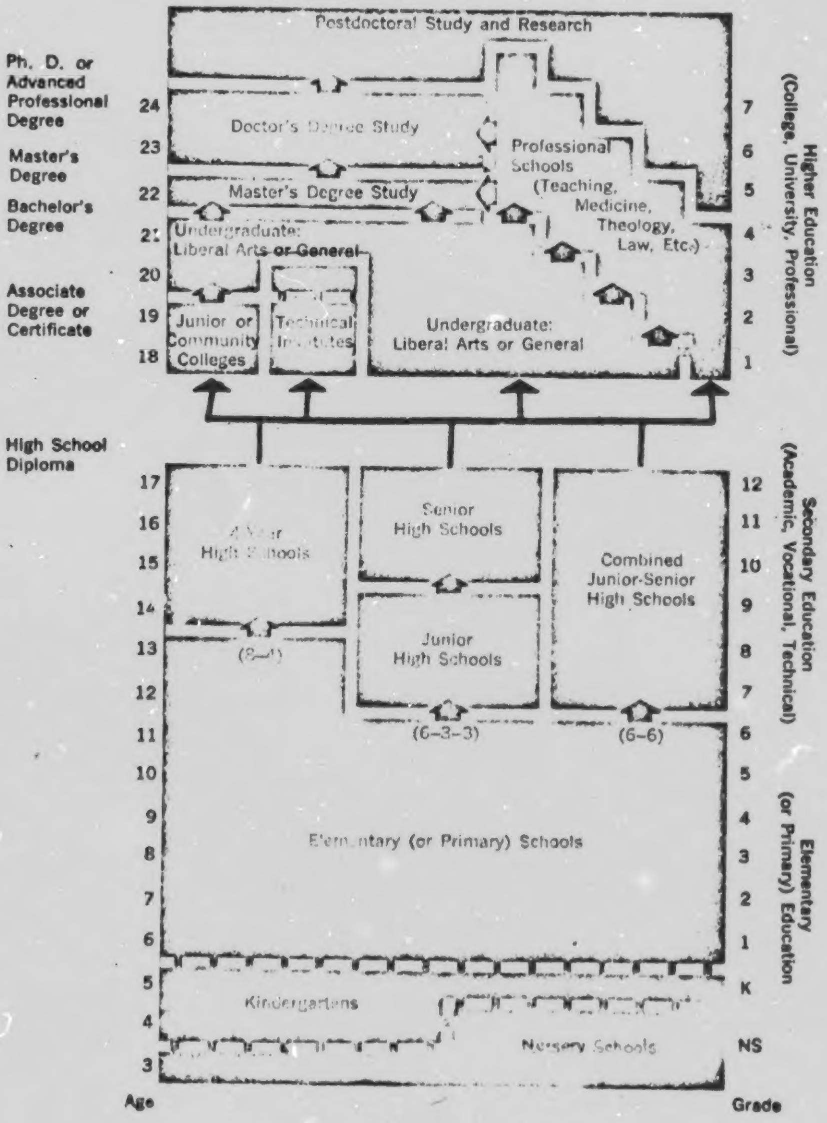
This category includes formal schooling from grades K through 12. Because of the number of individuals involved, it constitutes a major potential market for educational telecommunications, one which has proved difficult to penetrate. It includes what is generally referred to as traditional schooling, but also can include a variety of new approaches and innovations, e.g. "free" schools, "alternative" schools, or "open classrooms" which have sprung up at the elementary and secondary level.

2. Higher Education

Here we include post-secondary education leading to a formal degree. Included are universities, colleges, junior and community colleges. Innovations such as the "Open University" of the State of Nebraska and the PLATO and TICCIT Computer-Aided Instruction (CAI) demonstrations are occurring at this level. These demonstrations promise to be important elements in determining the future growth or lack of growth of educational telecommunications. Growing interest in non-traditional approaches to

FIGURE 1

The Structure of Formal Education in the United States
(From Ref. 22)


Postdoctoral Study and Research
Ph. D. or Advanced Professional Degree
Master's Degree
Bachelor's Degree
Associate Degree or Certificate
High School Diploma
Doctor's Degree Study
Master's Degree Study
Professional Schools (Teaching, Medicine, Theology, Law, Etc.)
Undergraduate: Liberal Arts or General
Junior or Community Colleges
Technical Institutes
Undergraduate: Liberal Arts or General
Higher Education (College, University, Professional)
4-Year High Schools
(8–4)
Senior High Schools
Junior High Schools
(6–3–3)
Combined Junior-Senior High Schools
(6–6)
Secondary Education (Academic, Vocational, Technical)
Elementary (or Primary) Schools
Elementary (or Primary) Education
Kindergartens
Nursery Schools
Age
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
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8
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6
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Grade
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K
NS

TABLE I

EDUCATIONAL SUB-SECTORS

Elementary and Secondary Education

Higher Education

Vocational/Technical Education; Career Education

Adult Education
(Basic and Continuing)

Continuing Professional Education

Early Childhood Education

Education for the Handicapped
(Special Education)

Education for Culturally Diverse Groups and Geographically Distinct Regions

Education for the Aged and Institutionalized higher education such as "external degree" programs and "open learning systems" may facilitate increased telecommunications use.

3. Vocational/Technical Education; Career Education

Vocational/technical education represents formalized instruction to either prepare students to enter an occupation requiring less training than a bachelor's degree, or to provide retraining. It is a difficult category to define, occurring at both the secondary and post-secondary level and overlapping at one end with activities of the junior colleges. Vocational/technical education now appears to have been intertwined with a new concept called "career education" but differs from career education in that the latter is not occupationally specific, whereas vocational/technical education is concerned with teaching specific job skills.

4. Adult Education

Adult education encompasses education for people 16 years of age and older who are not enrolled in school on a full-time basis. Sub-foci within adult education include adult basic education and adult continuing education.

5. Continuing Professional Education

Engineers, doctors, lawyers and teachers all share to some extent a need for continued professional growth and updating of professional skills through courses, seminars, etc. Telecommunication technology is used fairly extensively to bring televised instruction to engineers at industrial locations.

6. Early Childhood Education

This category is concerned with education during the child's youngest, most formative years prior to entering formal school systems at age 5 or 6. Early childhood education has been receiving growing attention during recent years. A popular public television program, Sesame Street, is designed to teach basic number, letter and other skills to pre-school children.

7. Education for the Handicapped

The category Education for the Handicapped is often referred to as Special Education when dealing with children of school age. Included are individuals with various non-normative characteristics: speech, hearing and visual impairments; mental retardation; orthopedically handicapped; etc.

8. Education for Culturally Diverse Groups and Geographically Distinct Regions

Various ethnic, minority and other subgroups of the larger society form identifiable units with needs which may be sufficiently diverse so as to warrant consideration of distinctive approaches to educational telecommunications utilization by each subgroup. Groups which may have unique educational needs include migrant workers, American Indians, Spanish-speaking Americans and Black Americans. Certain geographic regions are also singled out for particular attention because they have been the focal point for educational satellite activity. Such regions include Alaska, the Rocky Mountain States, and Appalachia.

9. Education for the Aged and Institutionalized

Here we include the elderly, who are becoming more organized and concerned about their treatment by society. The institutionalized includes those in nursing homes and prisons.

The above categories probably include a large proportion of the U.S. population. Industry's needs are considered briefly in the section on continuing professional education. We have not analyzed the situation in the military, although it is generally acknowledged that educational technology has been a significant factor in military training, more so than in non-military activity.

Each of the educational sub-sectors listed above will now be analyzed in more detail. Clearly, the relatively brief treatments of subjects as complicated as elementary and secondary education, and higher education, can not begin to do justice to the breadth and complexity of these sub-sectors. Because a major objective of this analysis is to provide a framework for estimating future educational telecommunications markets and system requirements, we have attempted for each sub-sector to focus upon the following:

a. Current numbers of individuals involved

b. Current modes of delivery

c. Issues of current concern

d. Trends

e. Factors working for technology utilization

f. Factors working against technology utilization

Another important consideration worth noting is that our emphasis is on large-scale educational telecommunications delivery systems. There may be considerable differences in conditions and factors affecting acceptance or rejection of an educational telecommunications system delivering television and computer-aided instruction to a consortium of users in a large number of states compared with factors affecting a local cable television system in one school district or a VTR* in one school. In some respects, the large-scale system has a more all-encompassing set of factors and conditions to consider.

With the above limitations in mind, we proceed with the sub-sector analysis.

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*Videotape Recorder.

B. ELEMENTARY AND SECONDARY EDUCATION*

1. Current Status and Trends

Table 2 summarizes some statistics concerning elementary and secondary education. Among the most significant trends accompanying the statistics are the following:

a) Stabilization of Enrollment

After 27 consecutive years of increasing enrollments, elementary and secondary school enrollments showed little, if any increase, from Fall 1971 to Fall, 1972. In fact, estimated elementary public school enrollments indicate a decline of more than 1% and non-public elementary school enrollments declined slightly also.[22] Secondary school enrollments rose by about 2% with all the gain coming in the public schools. Non-public secondary enrollment remained steady.

There is reason to believe that stabilized or declining elementary and secondary school enrollments may continue into the 1970's and 1980's. In 1972, 3.3 million children were born in the U. S., the smallest number of live births since 1946. The National Center for Educational Statistics projects a small annual reduction in elementary enrollments in the next five years because of a corresponding decrease in the population between the ages of five to thirteen.[22] By 1977, and for several years after that, this should result in a tapering off in secondary enrollments. Various enrollment projections, based on several different sets of

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*At the time this report was released, the 1973 editions of the annual Digest of Educational Statistics and Projections of Educational Statistics of the U. S. Office of Education had recently become available. The analysis to follow in Sections IIB and IIC is based primarily on the 1972 editions. Perhaps the most important trend which emerges in the 1973 reports is the downward revision in estimated future enrollments compared with those predicted previously, particularly for higher education. Significant new information from the 1973 editions has been included in this report. For an earlier analysis of needs, programs, demands and costs in early childhood, basic elementary and secondary education, see Ref. (304).

TABLE 2

STATISTICS CONCERNING PUBLIC AND PRIVATE

ELEMENTARY AND SECONDARY EDUCATION

(From Ref. 22)

Numbers are for Fall 1972, unless otherwise noted

Elementary and Secondary School Enrollments	TOTAL:	51.3 million
	PUBLIC:	46.2 million
	PRIVATE:	5.1 million
Elementary (Grades K through 8) Enrollments	TOTAL:	35.8 million
	PUBLIC:	32.0 million
	PRIVATE:	3.8 million
Secondary (Grades 9 through 12) Enrollments	TOTAL:	15.5 million
	PUBLIC:	14.2 million
	PRIVATE:	1.3 million

Persons employed in Public Elementary and Secondary Schools[24]

Total Full-Time equivalent persons**	3.6 million
Total Instructional Staff (TIS)	2.6 million
Classroom teachers	2.1 million
Other professional staff	0.236 million
Non-Professional staff serving instruction	0.279 million

Pupil-Teacher Ratios in Public Elementary and Secondary Schools

In the Fall, 1972	~22
In the Fall, 1962	25.7

Average Salaries Expected, 1972-1973 for Public Elementary and Secondary Staff:

Classroom Teachers	$10,140
All Instructional Staff Members	$10,650

Total Educational Expenditures As percentage of Gross National Product:

In the year 1971-1972	8%
In the year 1965-1966	7%
In the year 1955-1956	5%
In the year 1943-1944	1.8%
In the year 1935-1936	4%

Expenditures per pupil in average daily attendance in Public Elementary and Secondary Schools:

In the year 1971-1972	$934
In the year 1961-1962	$419

Number of Schools:[22]

Public Elementary	65,800
Public Secondary	25,400
Non-Public Elementary	14,400
Non-Public Secondary	3,800

Number of Public School Districts:[24]

In Fall 1972	16,956
In Fall 1971	17,289
In Fall 1969	19,169

Federal Assistance to Elementary and Secondary Schools in 1970-1971: [25]

$3.8 Billion or 8.4% of total Revenue Receipts

Percent of local operating expenditures devoted to Instruction, 1971: 71%

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* Except where otherwise noted, these are estimates made by the National Center for Educational Statistics[22].

**Includes both instructional and non-instructional professional and non-professional positions.

assumptions, are summarized in a report by Denzau[26] of our research group.

A more recent set of projections in the 1973 Edition of *Projections of Educational Statistics* predicts that enrollments in all regular public and private elementary and secondary day schools will drop from 50.8 million in 1972 to 45.1 million in 1982. The decrease in enrollment at the secondary level is not expected to occur until 1979, when children born in the low-birth years of the late 1960's, reach high school age.[86]

b) Decline in Pupil-Teacher Ratios

Over the past ten years, pupil-teacher ratios in public schools have declined from 25.7 pupils per teacher ten years ago to approximately 22 pupils per teacher in Fall, 1972.[22] This decline is a result of the fact that the number of public school teachers has grown at a somewhat faster rate than the student population. However, there is reason to believe that this trend may not continue. Since 1971, there may have been a decrease in the number of elementary school teachers.* Furthermore it may be predicted that stabilization of numbers of instructional staff members may follow the stabilization of or decline in student enrollments. The recent teacher "surplus" is one indicator that this may be occurring. It should also be noted that about 20% of the total instructional staff of public schools consists of professionals and para-professionals who are not classroom teachers.[24]

c) Increase in Educational Expenditures

Since 1943-44, there has been an increase in expenditures for education, reaching a total of about 8% of GNP for all educational levels in 1971-1972.[22] Per pupil expenditures in public schools have more than doubled in the last ten years, currently reaching around the $1000 per pupil figure.[25] In recent years, growing taxpayer's resistance to school bond and tax issues has occurred which is likely to slow down the rate of increase of educational expenditures, along with the effect of stabilization of or decline in enrollments.

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*The latest estimates indicate that from Fall 1972 to Fall 1973 the number of elementary school teachers fell slightly whereas there was a slight increase at the secondary level.[87]

d) Decline in Number of School Districts

There has been a pronounced decline in the number of school districts from 84,000 in 1949-50 to 17,000 in Fall, 1972.[22] This decline is a result of reorganization laws, consolidation of small districts and elimination of non-operating school districts. Paralleling this decline has been a sevenfold increase in federal expenditures in elementary and secondary schools over the past decade.*

e) Increase in Duration of Schooling

A recent computation by the U. S. Office of Education indicates that young people are staying in school longer than ever before.[22] In 1970, some 76% of the seventeen year old population graduated from high school. The percentage of young adults entering college has increased substantially over the past decade to the point where in 1969, some 60% of recent high school graduates entered formal, post-secondary education.

2) Issues

a) Equality of Educational Opportunity

A recurring and difficult problem on the U. S. scene has been that of providing equality of educational opportunity. In the Coleman survey,[27] statistics were gathered on six racial and ethnic groups: Negroes, American

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*In 1970-71, federal assistance to elementary and secondary schools reached $3.8 billion or 8.4% of total revenue receipts.[22] For fiscal year 1974, the latest estimates are $4.1 billion at this level out of a total of $17.9 billion in all federal funds for education and related activities. FY 1974 totals are slightly less than FY 1973 estimates. (87)

Indians, Oriental Americans, Puerto Ricans living in the continental United States, Mexican Americans, and whites. The report indicates that whites and Oriental Americans achieved at comparable levels in such areas as verbal and mathematical skills whereas the other minorities achieved at sharply lower levels. The gap grew greater as the children progressed through the school system. To put it another way,[5] "Schools tend to deliver best to those segments of society which have always done well in school. Middle and upper class students seem to receive the greatest benefit from school, while lower class students, and members of minority groups do not, in general do as well."

The national response to this problem has been spotty and has produced mixed results. Efforts include Title I funds and O.E.O. performance contracts, compensatory education, emphasis on "accountability," increased emphasis on education for the world of work, alternative schools and experiences for high school dropouts, "free" schools, open classrooms, Sesame Street, integration, community control of schools, proposals for educational vouchers, proposals to "deschool society," creation of a National Institute of Education.

Although some studies have tended to support the hypothesis that the socio-economic status of the students is the controlling variable in how well he or she does in school, others do not discount the importance of physical and human resources. As Harold Howe has pointed out, "...without significant changes in educational practice, simply providing modest amounts of additional money has a low payoff. I do believe, however, that the kinds of gross differences in funding, on which the California (court) decision is based, do affect children's opportunities. ...I would assert that the well-run, high expenditure district provides its pupils with many opportunities that would benefit the child from the lower expenditure district."[28]

Although the issue of inequality in our society seems to receive less attention in the seventies than in the sixties, the achievement of social justice and equal educational opportunity remain important unfinished business on the United States agenda.

b) Individualization of Instruction

The American school system has been able to "teach" the vast majority of students and is one of the leading examples of mass education. However, as Koerner has pointed out,[29] professional educators for most of this century have been talking about the importance of "individual differences" among students and how to provide for them. "Educators, faced with the sheer number of students at every level of the system, have never found a way out of the lockstep structure, with its rigid timetables, set courses of study, instruction in groups (often very large groups) and progress measured out in credit hours. Of necessity, most students move through the educational system in blocs rather than as individuals. They increasingly resent it, just as educators increasingly regret it."[29]

At the elementary and secondary school level, moves to accommodate features of the "open classroom"[30] or the English System[31] would appear to be in response to this need for individualization or rehumanization. Technology may also be another element in moving towards individualization.

c) Financing Education

Perhaps no issue is of more immediate concern to school teachers, administrators and board members than that of financing education. School budgets have grown rapidly over the past decade with the bulk of the funds going into instructional salaries in this very labor-intensive sector.

Caught in the growing squeeze of inflation on one hand and other demands such as for defense spending on the other, taxpayers are much more reluctant to pass school tax and bond issues. Court decisions have forced a re-examination of the funding base for education and some states are considering moving to forms of funding other than relying heavily on property taxes.

Stabilization or decline of school enrollments appears to be easing the pressure for increasing school spending. Some school districts respond by not hiring new teachers or by closing schools. Increased unionization may serve to win better conditions for a pool of teachers that levels off in numbers. These trends may serve to slow the rate of increase in educational spending and begin to decrease education's share of the GNP.

d) Other Issues

Education is a complex activity which everyone has opinions on and experience in. This brief discussion of issues can not hope to do the field justice. Some additional issues or needs which emerged from a "brainstorming" session involving Washington University students include: a) more diversity in education, b) the need to humanize education, c) education for life--closer relations between schooling and the real world, d) alternatives to traditional education.

3. Technology in Education: Rationale

There are at least two rationales for more extensive use of technology in public school education. These will now be presented.

a) Productivity and Efficiency in Education

An issue of concern to planners, policymakers, school board members and taxpayers is that of how do you get the public schools to become more productive. The National Academy of Engineering addressed this issue in a report of its "Workshop on Application of Technology to Improve

Productivity in the Service Sector of the National Economy."[32] A major study on the subject of "Producticity and Efficiency in Education" has also been undertaken by a panel of the Federal Council on Science and Technology.[33]

Estimates of percentages vary but it is true that education is probably the most labor intensive of all major sectors, with one estimate being that over 74% of current outlays in elementary and secondary education go into salaries.[5] Thus, for some, education looms as a frontier for applying those techniques, concepts and technologies which have worked in other "industries." Supporting this argument is the fact that per pupil expenditures have been rising faster than would be explained by inflation, indicating that the increase of costs for education over the last few years has not been solely attributable or proportional to increasing enrollments.[13]

It can be argued that continued increases in teachers salaries coupled with decreases in costs of computer and communications technologies give rise to a situation in which partial substitution of teachers by technology or by technology and paraprofessionals is inevitable, in spite of possible strong resistance to such a development among teachers, unions, etc. This attitude is supported by some cost models of educational inputs[34] which tend to be speculative and which do not take into account some of the more qualitative or "affective" inputs of education. Aspects are linked to outputs by the generalization that there is "no significant difference" in effectiveness between teachers and instructional media.* Savings are possible by going to higher pupil-teacher ratios,** which may not have much influence on learning outcomes. Savings may also be made possible by reducing the time required to master cognitive skills through use of technology. Currently the portion of school budgets spent on instructional materials may be more than 2-4% of the total budget.

Anderson and Greenberg in a study entitled "Educational Production Functions for Teacher-Technology Mixes: Problems and Possibilities,"[13] have examined prior research relating educational inputs to educational outputs through use of educational production functions. This topic is very pertinent to considerations of productivity in school systems. Although changing the inputs to education by introducing technology may hold forth promise of increasing productivity, it is the relation between the inputs and outputs, and ultimately the output itself which is of key importance.

The Anderson-Greenberg study concludes with some insights which point the way towards future undertakings related to school system productivity:

> "Our original expectation was that we would be able to find enough studies using the same media to teach a subject that

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*Jamison, Suppes and Wells have reported on a survey they undertook to provide an overview of research on the effectiveness of alternative instructional media. The media considered were traditional classroom instruction (TI), instructional radio (IR), instructional television (ITV), programmed instruction (PI), and computer-assisted instruction (CAI). Achievement test scores were the measures of effectiveness most frequently used. It is concluded that "students learn effectively from all these media, and relatively few studies indicate a significant difference in one medium over another or of one variant of a medium over another. (P. 52.)." However, the authors point out that the present state of the literature is preliminary in nature as far as providing a basis for deep understanding of the strengths and weakness of technological alternatives to traditional instruction. (34)

**Denzau's work[26] indicates a saving of about $1 billion for an increase of one in pupil-teacher ratio in 1975.

> we would be able to derive some estimates of the "best" combination of teacher and media to produce a given output. This expectation turned out to be naive. Although there have been several hundred studies of media use, few are reported in sufficient detail to be useful, nearly all have merely substituted a television performance for a live lecture and then made comparisons on a standard test which, for all we knew, could have been based on a textbook. There were not many studies which systematically varied the mix of teacher and media and sought differences in output which could be associated with each type of combination. These are the sorts of studies which must be undertaken to produce data which has much practical utility.
>
> "There are, of course, educational outputs which cannot presently be quantified, some of which may never be satisfactorily measured. But many educational objectives particularly at the elementary and secondary levels, can be and are measured. The difficulty of defining outputs should not be taken as an excuse to do nothing; at a low enough level of aggregation -- such as reading or addition -- reasonable people can agree on what constitutes acceptable levels of performance. However, educators and parents will have to agree on the desirable outputs, and methods to teach these skills with as few undesirable side effects as possible will need to be investigated. This done, we may find that adverse side effects are more often the result of frustration from not learning anything, than the result of a technique which successfully teaches reading, arithmetic, or some other subject (p. 41-42)."

Anderson and Greenberg's remarks highlight two areas for future research directed towards improving school system productivity through educational technology, namely: 1) documentation and evaluation of cases from a cost-effective or production function point of view in which teacher-technology mixes have been or are being utilized and 2) experimentation with new combinations of teachers and technology in which inputs are carefully selected and outputs carefully evaluated. Without such information, it may be difficult to convince school boards and school administrators to adopt more technological approaches to education.

A note of caution is required in extending the concepts of productivity and cost-effectiveness to education. Educating human beings is a much different process than mass-producing cars or growing tomatoes. The very concept of productivity itself, although appealing to technologists and taxpayers may, if implemented thoughtlessly, turn-off the people most intimately involved in the educational process, namely the teachers and students. There clearly are difficulties in defining the "outputs" of education in any productivity model and technology's role may be a limited one. Therefore, experiments with teacher-technology mixes should be viewed as just that: namely experiments. Impacts upon children, teachers and society as well as test scores should be carefully and impartially evaluated. Productivity related cost-effectiveness and cost-benefit studies and demonstrations require thoughtful consideration of the words after the hyphens. Technology can help free minds or it can help enslave them. Minds are what education is all about.

b) Quality and Diversity in Education

In contrast to the strong emphasis on productivity and efficiency, another rationale for increasing use of technology in public school education can be its potential to provide better quality and more diversity in education. Technology becomes an additional tool for educating students which students can have access to either directly or through teachers. It can provide a way of allowing a teacher to "reach" some students while concentrating time and attention on others. What works best for one child may not work best for another.

To sharpen the distinction between this approach and the productivity approach, the former might be based on using whatever combination of technology and teachers is required to bring about a desired educational outcome. This could conceivably require more resources than education without technology. Whether or not society is willing to pay more in hopes of doing a better job remains to be determined.

Although productivity arguments emphasize the need to slow down or halt the increase in educational spending, it can be argued that education, because of its intrinsic social and human value, should require even a greater percentage of the GNP than it now utilizes. Only 8% of the GNP is being spent on an activity directly involving 3 out of every 10 citizens and indirectly involving many more, in contrast, say, to defense spending in which direct involvement is much smaller.

It should be pointed out that the rationales of productivity and diversity may not be mutually exclusive. As technology utilization evolves, it may be able to satisfy partially the rationale for both.

4. Technology in Elementary and Secondary Education: Selected Uses

In this section, some selected uses of technology in elementary and secondary education are described. Some material presented in this section and other papers of interest can be found in the Final Report of the Symposium on Improving Productivity of School Systems Through Educational Technology.[35] Chapter III contains additional information on some of the educational telecommunications services to be discussed in this Section.

a) Educational Television and Radio

Television and radio are media which are familiar to students and teachers. The adjective educational when used with these nouns is often taken to encompass both instructional and public television and radio. Instructional usually refers to the use of these media for instruction within a formal school setting or instruction which leads to some form of certification. Public came into use with the creation of the Corporation for Public Broadcasting and usually connotes cultural enrichment. However, the distinction between public and instructional becomes blurred as the Public Broadcasting Service begins to distribute television programs such as "Electric Company" which are viewed within formal school settings.

A study by DuMolin[10] indicates that there appear to be few reliable data on the extent to which instructional television and radio are used in classroom settings. What data there is (and it is somewhat dated) suggests that a relatively small percentage of classroom time (less than 5%) is devoted to watching television. Causes of this situation include lack of quality programming, inflexibility in scheduling, teacher resistance, and lack of resources when technology utilization represents an add-on cost. There is a dearth of literature which documents successful examples of ITV and IR use, particularly from a cost-effectiveness point of view. A study by Jamison and Klees[35A] carefully analyzes costs of instructional radio and television for developing countries but equivalent analyses do not appear to be readily available for the U. S.

Of the delivery systems for ITV, two that have found use are closed-circuit TV (CCTV), and broadcasts by educational stations or via educational networks. Closed-circuit TV installations generally rely heavily on local programming although the trend seems to be away from local programming and towards using national distribution mechanisms for programming such as NIT and GPNITL.* Washington County, Maryland and Dade County, Florida are often cited as being successful examples of use of closed-circuit TV in school systems. Detailed cost-effectiveness** and/or cost-benefit** studies for these systems would be of considerable interest to educational planners. A variant of CCTV is the Instructional Television Fixed Service, which is utilized heavily by parochial schools. Extensive information about various educational electronic broadcast services can be found in a report by Singh and Morgan[9].

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*NIT = National Instructional Television (Bloomington, Indiana).

GPNITL = Great Plains National Instructional Television Library (Lincoln, Nebraska).

**For a discussion of these concepts as applied to education, see Grayson[36].

The relationship between educational TV broadcasting stations and public school systems is sometimes difficult. In St. Louis, at one time, the school board paid the local educational station a lump sum to compensate for the instructional programs being broadcast. As budget pressures on the school system became severe, this contribution was withdrawn, leaving the TV station to try to devise other means of supporting such activity.

Some schools are tied together in state instructional television networks, South Carolina being a leading example. DuMolin[10] reports that in South Carolina as of 1970, ITV had gradually assumed the major responsibility for instructional content for mathematics in grades 4-12 and physical sciences in the high school. Interstate educational networks (e.g. Eastern Educational Network and Southern Educational Communications Association) have been formed to facilitate sharing among states in various regions.

With the advent of a delivery system for educational television and radio that is national in scope through the creation of CPB, PBS and NPR,+ both new opportunities and new problems were created. Through a nationwide interconnection, more than 200 ETV outlets are able to carry programs with the potential for reaching three fourths of the U. S. population. One program designed to teach basic letter, number and other skills to preschoolers, namely Sesame Street, has provided an impetus for renewed interest in public television, stirred a lively debate about pre-school educational strategies and provided educational researchers with a wealth of data with which to attempt to evaluate cost-effectiveness of television

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+ CPB = Corporation for Public Broadcasting
PBS = Public Broadcasting Service
NPR = National Public Radio

in education. The program illustrates the way in which quality programming can be produced and distributed at extremely low per viewer costs, reported by Rothenberg[15] as $1.29 per pupil, provided that a large scale distribution system exists to achieve economies of scale. Sesame Street, by capturing a large number of viewers, has also stimulated interest in educational programming on the part of commercial television.

Still another step was taken with the development and distribution of "The Electric Company," a program designed to teach reading skills, which are usually taught within an elementary school setting. The program is broadcast in some areas twice a day, and one of these broadcasts occurs during school hours. Evaluations of "The Electric Company" are therefore of great importance. It is reported that "The Electric Company" was viewed in 22.8% of the schools in the U.S.[37] in 1971-1972.

The widespread, rapid impact of Sesame Street and Electric Company was made possible by the existence of a large-scale organizational framework for rapid delivery, namely public television. Whether future developments of this kind can be expected depends upon the future of public broadcasting in the U.S. Key issues which have been confronted in the early 1970's include decentralized versus centralized control; long-term versus short-term financing; independence versus political interference. If public broadcasting can emerge from these battles in a cohesive way with firm financial support free from government interference, it seems reasonable to expect that public television will wish to become more heavily involved in instructional broadcasting, using regional or national consortia to cooperate in program production. A national organization called the Agency for Instructional Television has been formed which involves local public broadcasting stations in production of programs for school age children. An advisory committee to the Corporation for Public Broadcasting is currently involved in a study of what the Corporation's future role should be vis-a-vis elementary and secondary education as well as other educational sectors.

Relatively little has been said about radio here, which perhaps typifies the way in which it has been neglected in the U. S. as an instructional medium. It has been used previously with good results in many places, including the St. Louis public schools. National Public Radio exists to provide an organizational framework for national delivery. Radio is relatively inexpensive, ubiquitous and worthy of more attention than it has yet received.

Two delivery mechanisms which could potentially play an important role in increasing the use of television and other media in education are cable systems and communication satellites. The former might provide for more flexibility in program scheduling and more variety whereas the latter could extend the reach of television and other media to rural and remote areas. Each of these will be considered in turn.

b) Cable Communication Systems

Cable television, often called Community Antenna Television (CATV), began as a minor adjunct to the present system of over-the-air broadcasting in the late 1940's to bring distant TV signals to areas which did not have any coverage. Cable television was developed to provide TV coverage to small towns in wide and sparsely populated areas and is believed by some to have set the stage for a great communications revolution in major metropolitan and urban areas -- a revolution associated with the coming of broadband communication networks (BCN) or the beginning of a "wired nation."

As of the end of 1972, cable television (CATV) systems served at least 10% of U. S. homes.[39] Projections made prior to 1972 indicate rapid expansion of CATV in the U. S.; some studies project CATV penetration to reach as many as two-thirds of TV homes by the mid 1980's.[39, 40] However, 1973 saw a dramatic fall-off in cable television growth, casting doubt upon the validity of past projections.

The Federal Communications Commission (FCC) has ruled that return-communication on cable systems, at least on a non-voice basis,* is now demonstrably feasible and has required that cable systems be constructed with the potential of eventually providing return communication without having to engage in time-consuming and costly system rebuilding.[41] Such capability has the potential for promoting new interactive education services such as delivery of computing power to homes, learning centers and schools from a centralized source; "talk-back" television to provide interaction with a remotely located instructor; computer-assisted instruction (CAI); and educational information systems (EIS) implemented on an inter-school basis. A number of interactive television and data-file based inquiry systems have already been developed with cable-based delivery in mind. One such system, of considerable significance from the viewpoint of educational applications, is TICCIT (Time-Shared, Interactive, Computer-Controlled Information Television) under development at the MITRE Corporation under NSF sponsorship.[43]

The extent to which education will capitalize on cable communications systems, which are developing primarily commercially, is uncertain. The FCC[41] has ruled that cable operators must make available for educational purposes at least one channel in the major markets. Two other channels must be designated for public access and government uses. This is only for a period until 1977 when it is conceivable that, as former FCC Educational Commissioner H. Rex Lee is cited as having stated that they must "use it or lose it."[44] Our general impression is that there is a great deal of interest in the public access channel on the part of various groups.

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*With digital signal response.

However, the depth of interest on the part of school systems may be less strong.

Part of the problem is that one additional channel may not improve the capability for delivering media to the schools or increase the flexibility in using these media to any great extent over that which currently exists. On the other hand, imaginative uses of cable systems dedicated solely for educational purposes could make a marked difference. Barnett and Denzau[45] have set forth some options for dedicated educational cable systems and have provided cost estimates. They found that a 40 channel dedicated educational cable connecting all schools to a district head-end could provide TV instruction for an average of 20% of classroom time at a cost of about 2% of the average school budget.(p. 2) Such systems can provide multiple showing of the same programs so that the teacher has considerable flexibility in scheduling, although this flexibility is not as great as if videotapes or videocassettes are employed in each classroom.

The National Education Association has followed the development of cable television with interest and concern. In a booklet put out by their Division of Educational Technology,[46] Wigren quotes the position taken by the NEA Representative Assembly at their 1970 annual meeting:

> "The National Education Association believes that the use of Community Antenna Television (CATV) channels for education is essential to preserve the public interest, to afford an opportunity for educational innovation, and to encompass the learning needs of a diverse society.
>
> "The Association directs its officers and staff to seek the reservation of at least 20 percent of all CATV channels for educational purposes (Current Resolution 70-25) (p. 1)."

Wigren then goes on to present the NEA's statement to the FCC supporting this resolution. It would appear that in designating only one channel for education, the Commission was considerably less responsive than NEA desired. The Commission did, however, require two-way capability which NEA felt was especially important in planning for instructional uses of cable systems. Two-way communication may permit more active student involvement in learning. Cable becomes more than a one-way pipe for TV programs but as mentioned previously, permits voice and even video feedback as well as two-way transmission of digital data. However, it should be noted that existing and developing two-way systems are currently considerably more expensive than one-way systems.

c) Communication Satellites

Fixed and broadcast communication satellites* represent another technology which holds forth promise for use in education, particularly for information networking over long distances and delivery over wide areas. In contrast to the "single-route, fixed capacity" characteristic of terrestrial interconnection systems, fixed/broadcast satellites offer a "multiple-route, allocable-capacity" capability which allows for many new wide-area services in addition to those available from terrestrial systems in the past.

An international satellite system, INTELSAT, has been in existence since 1965. In the near-term future, we will see development of a number of domestic satellite systems in the U. S. Even though these satellite systems are primarily designed to provide fixed satellite services with relatively large ground terminals, they are likely to offer substantially reduced rates for long-distance telecommunications.

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*The difference between "fixed" and "broadcast" satellites emerges from the following definitions of service categories. The broadcasting-satellite service is a space communication service in which signals transmitted or retransmitted by satellites are intended for direct reception by the general public. The fixed-satellite service is a space communication service between earth stations at specified points. Two distinct categories exist in the broadcasting satellite service: systems that allow for individual reception by simple receiving units in homes, and systems which are designed for community reception. It should be pointed out that individual reception by unaugmented receivers in homes is not currently possible.

High-power fixed or broadcast satellites capable of interconnecting low-cost and small terminals located at user facilities represent a further development in satellite technology. NASA's Applications Technology Satellite-6 and the joint Canada-NASA Communications Technology Satellite (CTS) will be used in experiments to demonstrate the feasibility of such a service in the 1974-77 time-frame. However, there are currently no plans for an operational service of this kind.

Whereas cable television is usually of local concern, as is demonstrated by the essentially local nature of the franchising process, educational delivery systems which are hypothesized utilizing satellites generally require consideration of regional, national or even international organization and administration. Walkmeyer has analyzed the organizational problems associated with such systems which are very complex, in view of the essentially local or decentralized nature of education in the U. S.[47]

In a booklet published by the National Education Association entitled "Man-Made Moons: Satellite Communications for Schools"[48] some of the promise held forth by satellites is presented. Future experiments and policy questions are discussed. The NEA supports reservation of satellite space for educational purposes and encourages carriers to give preferential treatment to education.

Once again developments have been somewhat less than NEA might desire. Propelled primarily by commercial development, a generation of satellites are about to come into being which were designed with little or no concern for educational interests. As in the case of cable-TV, incremental gains in capability such as one more ETV channel or one satellite channel[+] in a domestic satellite operating with large, expensive earth terminals may not be very appealing to educators and the cry may then go up that they are uninterested in using the technology. The problem is that the technology and the system for delivery were never designed to meet the needs of the educator. Satellites may serve to interconnect cable television headends and ground microwave systems designed for commercial use in the not-too-distant future but this also may be of little value to school systems unless educational needs and requirements are taken into account.

A paper by Horley, of the Office of Telecommunications Policy of DHEW sets forth possible educational uses at a variety of levels (including elementary and secondary eudcation) for one satellite video channel operating in the 2.5 Ghz band.[85] Horley envisions some 2 hours per day of supportive programming at the elementary school level as being viable initially and a student controlled secondary school component for 5 hours per day. Distribution would be to several thousand low-cost receivers throughout the country using a 2.5 GHz transponder aboard a "hybrid" satellite also equipped for commercial operation in the 4 GHz band.

Satellites could serve to bring more educational resources to rural and remote areas provided that they have sufficient power to reach relatively inexpensive terminals. First generation commercial domestic satellites now coming into being do not have this capability. Television with

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[+] One commercial operator did originally offer in a proposal to the FCC 5 TV channels to educators for five years free of charge with an unspecified rate to be set after the five years. At this point in time, it is doubtful if this capacity could have been utilized even if the unspecified rate were also free.

talk-back, radio, data transmission, CAI are but some of the services which can be transmitted via satellite. (See Chapter III.) Some experiments for health and education are taking place in 1974-1975 in the Rocky Mountains, Alaska and Appalchia using a high-power, Advanced Technology Satellite, ATS-6. A follow-on experiment starting late in 1975 jointly with Canada will permit additional experimentation. However, a recent decision by NASA to phase out communication satellite development work is likely to seriously inhibit the future development of educational satellite systems, unless other federal agencies such as DHEW, CPB and NIE expand their activities and interests.

d) Videocassette Recorders, Portapaks, Etc.

Devices such as videocassette recorders, and portapaks seem to offer a maximum of opportunity for creative involvment by individual teachers and students. Barnett and Denzau[45] have recognized the great flexibility of videotapes and have provided costs for two systems: one in which each school has one mobile TV set and VTR per five rooms; the other in which there is a TV set and VTR in each classroom. They feel that VTR's are more likely to be accepted by teachers than other technologies because they can control their use. Hence the primary purpose of the first of these two systems is for experimentation and learning by classroom teachers. In their expanded system, such devices can be "networked" through mailing of tapes although tape costs and storage are important economic factors. However, the cost of the expanded videotape system is estimated to be more than twice that of a 40 channel cable system.

e) Computers

Computers are used in education for research, administration and instruction,* primarily in higher education. However, below this educational level, there has been considerable usage, particularly for administrative purposes in secondary schools. Although instructional usage seems to attract the most attention on the part of educators, the impact of computers on educational administration seems worth examining within the framework of school system productivity. A recent book by Umans highlights the potential benefits to be derived.[49]

There are a number of instances in which computer-aided instruction (CAI) has been extensively used in school systems. Charp has described the CAI program in Philadelphia schools and has stated that "What is available now are measurable results and valid statistics showing an increase in student learning through information released from schools in New York City; McCoomb, Mississippi; Chicago; Philadelphia; and Waterford, Michigan among others."[50] In a Title I initiated project in the Chicago public schools, as of 1973, 7,000 students were learning reading and either math or language arts skills through CAI using 512 terminals in 32 schools.

Two major new CAI demonstrations are currently being implemented; one using the large and highly centralized Plato-IV system (Programmed Logic for Automatic Teaching Operations) developed by the University of Illinois, the other the TICCIT (Time-Shared, Interactive, Computer-Controlled, Information Television) system developed by the MITRE Corporation. Although these systems differ considerably in their technical characteristics and capabilities, they have a common objective of providing CAI services at costs commensurate with those involved in teacher-administered instruction. In contrast to the $5.85 per student-hour costs for CAI instruction quoted for a college level physics course for the period 1965-1969 with commercially available systems,[51] Plato-IV is estimated to cost $0.34 per student-hour[52] while the combined monthly charge for TICCIT and basic services is estimated in the range $19.50-$24.20.*[43]

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*Detailed reviews of computer technology and utilization in education have been prepared by Singh and Morgan [8, 11].

Plato-IV was originally designed to serve 4,000 special terminals containing a plasma display panel and with memory provided by a centrally located single large computer. TICCIT connects a small computer to home television sets via cable systems, using the TV set as a display device, equipment to record and display still pictures and a touch-tone telephone pad for interaction via the phone system. These demonstrations, along with other CAI work in progress, should provide useful information on the future potential of CAI in schools. Although a major part of the effort is directed towards use in junior colleges and institutions of higher learning, some elementary and secondary school involvement is planned for the Plato-IV project.

CAI poses a real dilemma for educators and school systems. If it is true that large-scale CAI systems will some day achieve a per pupil cost less than that of traditional instruction, and if it is true that students can learn certain subjects faster with CAI, just how do we get from where we are today to where we'd like to be in the future. CAI systems would seem to be incompatible with the kind of lock-step, graded schools we have today. CAI use may be more at home in other kinds of non-traditional situations. As far as large-scale replacement of teachers by computers is concerned, such a development seems neither possible nor desirable.

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*The validity of various cost estimates have not been scrutinized in this study. A somewhat higher estimate of PLATO-IV costs is presented by Eastwood and Ballard.[306]

5. Factors Working Towards More Widespread Technology Utilization

Some factors which are acting to bring about more widespread use of technology in the public schools have been analyzed by Lipman.[17] They include 1) the driving force supplied by the development of technologies and of the systems analysis techniques employed by agencies such as the DOD, NASA and the AEC, as well as the interest of those agencies in obtaining "spinoffs" for their efforts in the civilian sector; 2) the predicament of school districts which are being called upon to be pedagogically and fiscally "accountable" and which are flirting with the vision of using technology to obtain more cost-effective education; 3) the ascendance of a behaviorist learning theory which is supportive of the systematic use of technology to improve education. Lipman states that the convergence of these developments constitutes a powerful force working towards large-scale use of educational technology.

The first of these factors, the "spin-off" factor originates to a large extent external to the school environment and manifests itself initially in the form of personnel in government agencies or industrial concerns who come into educational administrative or policy making positions with background and training in systems analysis and cost-effectiveness studies. The federal government at this time probably remains the key agency as far as the extent to which this factor will manifest itself.

The second factor, centering on accountability, is more indigenous to the local school setting. However, resistance factors tend to be great and there are ways to respond to failed tax and bond issues other than by using technology. In fact, what little technology utilization there is may be the first thing to go in a budget crunch. To get from essentially teacher-based instruction to a teacher-technology mix will clearly require some external inputs, again with the federal government likely to be the key factor.

The third factor, that of behaviorist learning theory, is but one of a number of trends in education which tend to provide a stimulus. The rise of the free school movement and the open classroom is another such trend which to some extent counteracts the former. The extent to which these trends finally become institutionalized remains to be seen. However, Lipman's warnings about the dangers inherent in widespread use of monolithic programmed instruction deserve further attention and evaluation.

Of course, the technology itself may have appeal. Imaginative, well-funded programs like Sesame Street and the Electric Company reach large numbers of children. Visually oriented youth brought up on a diet of television viewing may seek additional visual stimuli in school.* Early computer-aided instruction experiments indicate significant learning gains, particularly among slow learners.[34] VTR's and portapaks provide opportunities for creative teachers and students to express themselves. The potential offered by the technology is there to be seized upon.

The following steps have been recommended by Anderson and Greenberg as facilitating the large-scale utilization of instructional technology:[5]

1. The collection of data on achievement of pupils in schools so that media can be assessed in terms of their cost-effectiveness for pupil achievement.

2. The separation of the certification function from the teaching-learning process, perhaps by having skills assessed by someone other than the teacher.

3. The basing of financial support of schools on results obtained rather than on pupils incarcerated and teacher qualifications.

4. The development of better management talent in school administrators and teachers.

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*There are some who feel that children need less, not better television.[37]

Sometimes the voices of influential individuals can affect future development in education. Coleman[53] sees technology as one part of a series of developments which will alter educational institutions in the years ahead. He feels that if educational changes are to come about in an orderly manner without social convulsions, "it is necessary, first, to remove many of the classical school functions from their central place, and second, to replace them with functions currently not performed outside school." To accomplish the first task requires "an increased rate of development of technological aids for learning cognitive skills, use of vouchers or other means to bring about the learning of cognitive skills outside school, and substitution of achievement tests for course requirements." However, there appear to be relatively few educators who share this point of view at the current time.

6. Factors Working Against More Widespread Technology Utilization

Resistance factors to technology utilization in schools have probably received far more attention than factors favoring adoption. Some of these resistance factors include[54] confusion concerning definitions and objectives; teacher resistance; the "hardware-software dichotomy" in which software lags behind hardware; lack of standardization of equipment; the lack of conclusive research and evaluation. For instructional television, lack of quality programming, inflexibility in scheduling, and lack of resources when technology represents an add-on cost are cited as major resistance factors.[10]

To date the utilization of technology in public elementary and secondary schools has been at a relatively low level. A 1967 study indicated that television viewing, the most utilized of the large-scale technology, occupied no more than five percent of classroom time.[10] Little if any effort is made to assess the extent of technology utilization in education. The lack of a substantial, well documented base of experience with technology utilization in the schools, including cost-effectiveness and cost-benefit analysis may be the single most serious impediment to future utilization. It may also account for the fact that costs of technology utilization are consistently underestimated.[54]

As far as computer-assisted instruction is concerned, there is currently relatively little overall utilization in school systems, although as indicated previously, some use is reported in New York City, Chicago, Philadelphia and several other cities. A study by Anastasio and Morgan[55] has identified the following factors that have inhibited more widespread use of computers in the instructional process: 1) an inadequate system for software production and distribution; 2) lack of demonstrations of CAI and efforts to convince people that CAI is cost-effective; 3) an absence of adequate theories of instruction on which to base CAI systems; 4) the need to change the traditional roles of teachers so as to take advantage of CAI; 5) high costs of CAI; and 6) a need for technological research and development.

If it is desired to gain more widespread technology utilization through reduction in the professional teacher force, the resistances are likely to be great. Teachers unions are increasing in strength. Teacher-pupil ratios are mandated in many states and tied to accreditation. Schools are usually funded on such bases as enrollment or teacher qualifications. The widespread use of media other than textbooks for instruction raises new issues related to selection and approval of instructional materials, and to copyright restrictions which are yet to be resolved.[88]

7. Conclusions

Although there appears to be increased concern with productivity and efficiency in education, resistances to increased technology utilization for instruction in public elementary and secondary schools are great. The large number of elementary and secondary school students in the U. S. would make this sector one of particular interest to designers of a large-scale educational telecommunications system. However, early efforts to demonstrate the instructional uses of such a system might best not focus on the public schools.*

A key factor in fostering technology-based alternative systems is long-term, adequate federal support for experiments and demonstrations. There is need to provide support for innovative individuals whose efforts can make a difference on terms which do not stifle creativity and imagination. Sesame Street and the Electric Company are two examples of such innovative efforts. The latter program is receiving considerable utilization within schools.

Acceptance of technology by teachers might be improved if technology were to become a concern of university-level teacher training institutions. Until teachers themselves become interested in using technology, its introduction in school systems will be difficult. Furthermore, increased unionization and legal restrictions concerning teacher-pupil ratios and accreditation present formidable barriers to technology utilization. Therefore, it may be best initially to try to demonstrate productivity increases outside of the formal, traditional school system.

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*Private schools are believed to be more receptive to instructional technology use, with Catholic schools being heavy users of ITFS (Instructional Television Fixed Service) Systems. However, whether they would be able to support a large-scale system financially is another matter.

Of the two principal rationales for technology utilization, namely 1) increasing productivity and 2) improving quality and increasing diversity, the productivity rationale has received considerable attention of late, in response to rapidly rising educational costs. However, at the elementary and secondary school level, we are now entering a period in which enrollments are dropping and the instructional staff is stabilizing. Some school districts have been able to avoid drastic cutbacks in services because of decreased enrollments. It seems conceivable that in a no-growth situation, it might be possible to free up resources to focus upon improving the quality of education, using technology as a tool to aid in the instructional process. To do so will require the development of a substantial, well-documented base of experience with and evaluations of technology utilization in elementary and secondary education.

C. HIGHER EDUCATION

1. Current Status and Trends

Table 3 summarizes some statistics concerning higher education in the U.S. Most of the statistics presented in that table are based upon the 1972 editions of the Digest of Educational Statistics(22) and Projections of Educational Statistics.(56) In the discussion of significant trends accompanying the statistics which follows, an effort has been made to update the analysis to include projections made in the 1973 editions of these reports which became available shortly before this Needs Analysis report was issued.(86, 87) Perhaps the most significant difference between the 1972 and 1973 report projections has been the changing enrollment patterns in higher education which has led to significant downward revisions of the number of students enrolled in degree-credit programs.

a) Modest Increases in Degree-Credit Enrollments Through the 1970's

Higher education degree credit enrollments should continue to grow throughout the 1970's although at a considerably slower rate than the 1960's. The traditional higher education undergraduate age population (18-21 years old) which increased by 41% from 1962 to 1972 is projected to increase by only 6.4% from 1972 to 1982.(86) Whereas for the years from 1965 to 1970, degree credit enrollment increases averaged almost 500,000 students per year at the bachelors level or higher, in the two years from 1970 to 1972 they rose only about 200,000 and 150,000. Furthermore, although the percentage of 18 and 19 year old women enrolled in degree credit courses in college increased slightly (by 1%) from 1968 to 1972, this percentage has decreased by over 5% during the same period for men, resulting in decreases in first-time degree credit enrollments in the 1970-1971 and 1971-1972 academic years.

Table 3: Statistics on Higher Education, Fall, 1972*

Total Number of Students Estimated to be Enrolled in Degree-Credit Programs** in Universities, Colleges, Professional Schools, Teachers Colleges, and Junior Colleges,

in Fall, 1972:	TOTAL	8.22 million
	PUBLIC	6.12 million
	NON-PUBLIC***	2.10 million
	UNDERGRADUATE	7.29 million
	GRADUATE	0.93 million
in Fall, 1969:	PUBLIC	5.11 million
	NON-PUBLIC	2.02 million
in 1949-1950:	PUBLIC	1.35 million
	NON-PUBLIC	1.30 million
in 1929-1930:	PUBLIC	0.533 million
	NON-PUBLIC	0.568 million

Percent of Population Between 18 and 24 years old enrolled:

in year 1950	14.2%
in year 1960	22.2%
in year 1971	31.6%

Number of Full-Time and Part-Time Resident Instructional Staff:

in Fall, 1972	TOTAL	620,000
	PUBLIC	415,000
	NON-PUBLIC	205,000
in Fall, 1971	TOTAL	603,000
	PUBLIC	399,000
	NON-PUBLIC	204,000
in Fall, 1961[56]	TOTAL	292,000

Estimated Expenditures: In Billions of Dollars

in 1972-1973	TOTAL	32.5
	PUBLIC	21.8
	NON-PUBLIC	10.7
in 1971-1972	TOTAL	29.9
	PUBLIC	19.9
	NON-PUBLIC	10.0
in 1961-1962	TOTAL	8.5
	PUBLIC	4.7
	NON-PUBLIC	3.8

Median Salary for Instructional Staff at 4-year Colleges and Universities:

in 1971-1972	$12,932
in 1961-1962	$ 7,486

Tuition and Fees, and Room and Board Rates, All Institutions:

in 1963-1964	PUBLIC	$234
	NON-PUBLIC	$1,012
in 1968-1969	PUBLIC	$295
	NON-PUBLIC	$1,383
in 1973-1974	PUBLIC	$412
	NON-PUBLIC	$2,044

Current Fund Expenditures in Billions of Dollars, by Purpose, 1969-70

Total	21.0		
Educational and general		15.8	
General Administration and General Expense			2.63
Instruction and Departmental Research			6.88
Extension and Public Services			.52
Libraries			.65
Plant Operation and Maintenance			1.54
Sponsored Activities Other than Research			.77
Sponsored Research			1.84
Other Separately Budgeted Research			.30
Related Organized Activities			.65
Auxiliary Enterprises		2.77	
Student-Aid Grants		.98	
Major Public Service Programs		1.50	

Number of 2-year Institutions and Enrollments:

	Number of Institutions		Enrollments	
in year 1947	TOTAL	480	TOTAL	222,045
	PUBLIC	250	PUBLIC	163,005
	NON-PUBLIC	230	NON-PUBLIC	59,040
in year 1969	TOTAL	813	TOTAL	1,528,429
	PUBLIC	577	PUBLIC	1,412,610
	NON-PUBLIC	236	NON-PUBLIC	115,819

Source of Funds Expended for Higher Education:

In 1967-1968

	$ Billion	%
FEDERAL	3.8	19.1
STATE	4.7	23.6
LOCAL	0.6	3.0
ALL OTHER	10.8	54.3
TOTAL	19.9	100.0%
TOTAL PUBLIC	12.3	
TOTAL NON-PUBLIC	7.6	

In 1972-1973

	$ Billion	%
FEDERAL	5.1	15.7
STATE	8.6	26.5
LOCAL	1.3	4.0
ALL OTHER	17.5	53.8
TOTAL	32.5	100.0%
TOTAL PUBLIC	21.8	
TOTAL NON-PUBLIC	10.7	

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*Except as noted, estimates from National Center for Educational Statistics.[22]

**Excludes undergraduate students in occupational programs not ordinarily creditable towards a bachelors degree. In Fall, 1971 there were approximately 0.833 million such students.

***Designates control of institution.

Frankel and Beamer indicate that the end of the era of large enrollment increases that colleges experienced in the 1960's appears to have arrived. (86) Alternate projections of trends are now provided by the National Center for Educational Statistics because of changing enrollment patterns. The most recent NCES projections range from a high of 9.77 million total degree-credit enrollments in 1982 to a low of 8.08 million. The average of about 8.9 million for 1982 represents a small increase from the 1972 figure of 8.27 million.

It is interesting to compare these most recent projections with prior ones, first to gain appreciation for how difficult the forecaster's lot is, and second to indicate the extent of the changes in projections. These changes may force reexamination of long held beliefs based upon prior statistics which now do not appear to be materializing. A prior NCES projection had indicated that total enrollments in degree credit programs at all institutions would rise to 11.108 million from the 1971 level of 8.116 million. The Carnegie Commission on Higher Education, in a downward revision of previous estimates, predicted a total higher education enrollment of 11.5 million for the year 1980, a decrease to 10.6 million for 1990 and then an increase to 13.2 million for the year 2000. (57)*

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*In the Final Report of the Carnegie Commission on Higher Education, the difficulties in predicting future enrollment trends are stated as follows: "Here is the one major area where we wish to reconsider our earlier predictions and recommendations....We were among the first to call attention several years ago to the 1980's as a "stop" period after a century when enrollments had doubled every 10 to 15 years. But we did not anticipate that the declining rate of enrollment increases would occur so soon and so fast in the 1970's or that the 1990's might turn out to be such a period of continuing slow growth in enrollments, as now seems possible. We expected a new surge ahead beginning about 1990 - a new "go" period. We spoke of "new uncertainties" when we were making our earlier predictions, but we did not expect that they would come so soon or be so uncertain." (89)

The continued overall increase in degree-credit enrollments into the 1980's seems to be attributable to such factors as increased interest in higher education by individuals who are not in the traditional 18-21 age bracket and increased access to higher education for women. However, high school graduation rates which had increased from 69.3% of 18 year olds in 1961-1962 to 75.9% of 18 year olds in 1971-1972 are now projected to increase only slightly by 1982-1983. Decreases in birth rates which are showing up in elementary and secondary education will have its effect on higher education enrollments in the 1980's.

b) More Rapid Growth in Enrollment in 2-Year Institutions than in 4-Year Institutions

In 1962, 14.1% of all degree credit students were in 2-year institutions. By 1971, this percentage had risen to 21.7% and a projection indicates a figure of 25.1% by 1982.(86) In terms of absolute numbers of additional degree credit enrollments projected between 1972 and 1982, some 0.45 million places must be found in 2-year institutions compared with 0.21 million places in 4-year institutions.(86) First-time degree-credit enrollment in 2-year institutions is also growing faster than 4-year institutions, with some 45.6% of all first-time degree-credit enrollments expected in 2-year institutions by 1982.

c) Growth in Non-Degree-Credit Enrollment

There has been a large increase in non-degree-credit enrollments, almost all of it coming in 2-year institutions. The estimates, which are stated to be somewhat difficult to arrive at, show an increase from 186,000 in 1961 to 950,000 in 1972, with the largest increase coming from 1970-1971. The projected enrollment for 1982 is 1,489,000(86) which represents over 14% of total enrollments in institutions of higher education compared with 5% in

1962. It should be pointed out that non-degree-credit courses are usually occupational or general studies program courses not chiefly creditable towards a bachelor's degree but geared towards preparation for a technical, semiprofessional or craftsman-clerical position.

d) Increase in Costs of Educating College Students

In 1962-1963, the current expenditures (in 1972-1973 dollars) for all institutions averaged out to $1,807 per full-time equivalent college student for student education. Expenditures per student at privately controlled institutions were only slightly larger ($300) than at publicly controlled institutions. For the former, by 1971-1972, expenditures had risen to $2,508 and the projected figure for 1981-1982 is $3,271. By 1981-1982, it is projected that private expenditures will exceed public expenditures by over $1,200 per student.(86)

e) Increase in Relative Importance of Publicly Controlled Institutions

Approximately three-fourths of all enrollments in Fall, 1972 were in publicly supported institutions compared with 50% in 1949-50. Practically no change (3% increase) is projected in private institution enrollment from 1972-1982 compared with a projected 10% increase in public institution enrollments. Total expenditures by non-public institutions are projected to rise about 36% to accommodate the 3% increase whereas public expenditures are projected to increase by 39% in constant 1972-1973 dollars. Much of this increase will be attributable to increased staffing in public institutions and increased salaries for instructional staff, although expenditures for instruction and departmental research accounted for only 32.7% of all expenditures in 1969-1970. The decrease in relative importance of private institutions has been highlighted recently by the closing of certain private institutions due to financial exigency. Students and their parents find it increasingly difficult to pay the high tuition costs of private institutions when lower tuition public institutions are available.

f) Increased Educational Achievement

A March, 1972 survey of educational attainment of the population by the Bureau of the Census found that the median number of school years completed by young people 20 and 21 years of age was 12.8 years, compared with 12.3 years for persons 45 to 54 years old and 8.6 years for persons 75 and over.(87) About 75% of young people today finish high school and 43% of them (58% of high school graduates) can be expected to enter a degree-credit college program. If present trends hold up, about 23% of persons in their late teens today will earn a bachelor's degree, 7% a master's degree, and more than 1% a doctorate.(87) Numbers of students earning degrees today at many levels are at all-time highs.

However, the latest NCES projections seem to indicate that we are entering a period in which achievement in higher education will tend to level off. Factors contributing to this situation might include decreased job demand for liberal arts college graduates and greatly increased federal support for vocational/technical education in recent years.

2. Current Issues

a) Introduction

The Final Report of the Carnegie Commission on Higher Education lists the following priorities for action, among others:(89) 1) preservation and enhancement of quality and diversity in education; 2) advancement of social justice; 3) enhancement of constructive change; 4) achievement of more effective governance; 5) assurance of resources and their more effective use.

Aspects of several of these issues will be discussed briefly.

b) Access

Notwithstanding the slowdown in increasing higher education enrollments which now seems to be occurring, the last decade has been marked by a movement toward universal access to higher education in the United States. However, as it is now structured higher education is too costly for many. The majority of college students come from middle-and upper-income families. Low socio-economic status has been a barrier to college entrance.(58)

In a 1970 study by Warren W. Willingham,(59) ratings for the "accessibility" of each college in the U.S. were developed. In general, a college was called "free-access" if one-third of its freshman class was admitted from the bottom one-half of their high school class and the tuition and fees amounted to $400 or less. On this basis, 789 free-access colleges were identified. Only 42% of the U.S. population lives within commuting distance of these colleges. Willingham's analysis indicates that some 375 additional colleges in optimal locations would be required to put roughly two-thirds of the population of most states near an accessible institution. He states that because colleges can not be expected to be located optimally the 550 new colleges recommended by the Carnegie Commission* would raise the proportion of the U.S. population covered from about 4 in 10 to about 7 in 10.(59)

Increased access has been fostered by the rise of the community or junior college, probably the most important U.S. educational innovation since the land-grant college. Because of their relative newness, their rapid growth and lack of tradition compared with 4-year colleges, some feel that community colleges are fertile ground for technological innovation.

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*Although the numbers of colleges recommended would probably be reduced in view of the recent downward revision in predicted enrollments, Willingham's computation would seem to still be valid.

It has also been pointed out in connection with a study of developments in Black higher education that although providing opportunities for education beyond the high school level, it is yet to be determined to what extent community colleges provide access to further higher education or represent an educational "dead-end."(90)

Increased access can be fostered by a variety of mechanisms. The Open Admissions policy of the City University of New York is one. The "Open University" approach in which learning can take place at home with the aid of telecommunications is another, as are the growing number of "external degree" programs. A study recently completed by Wong examines the role of technology in non-traditional post-secondary education.(19A) Some 26 technology-based networks are described in which telecommunications technology is used to bring televised or other instruction to learning sites in industry or at satellite centers away from central campuses. In these instances, telecommunications provides a tool for access to higher education which might substitute for new buildings and some elements of supporting instructional infrastructure.

c) Equality of Educational Opportunity

Racial minority groups have been severely underrepresented in the U.S. system of higher education. Although the number of Black students enrolled in institutions of higher education more than doubled from 1964 to 1970,(58) the percentage of Blacks in college still lags behind the percentage of college age students represented by Blacks. The situation is even less satisfactory in graduate and professional education.

Women also have been underrepresented in the U.S. system of higher education. Enrollment rates (as a percentage of the relevant age group) are distinctly lower than for men. In addition, "there is evidence of discrimination against women in admission to institutions of higher education, especially at the graduate and professional levels, and there is a good deal of discrimination against women on college and university faculties."(58) Enrollment rates for women in higher education have shown some progress, rising from 38.0% of degree-credit enrollments in 1962-63 to 43.1% in 1972-1973 with a projected rise to 45.7% by 1982.(86)

At a time in which the increase in higher education enrollments is slowing down, increased emphasis on eliminating inequality of educational opportunity due to race, sex, family level of income and geographical location is needed. The Carnegie Commission recommends that all remnants of such inequality should be substantially overcome by 1980 and as completely as possible by the year 2000. To do so, they call for: 1) the creation of a sufficiency of open-access places, 2) the improvement of old and the creation of new alternative channels to life and work, 3) the financing of student costs where there is inability to meet them from personal resources, 4) the adjustment of higher education to students from a wider variety of backgrounds, and 5) the recruitment into faculty and administrative positions of more women and more members of minority groups.(89) Strong affirmative action programs are of particular importance in achieving this last goal.

The growing consciousness of women and minorities to their situation requires that particular attention be paid to their needs as articulated by them. In Section II.I, we have considered the educational needs of several culturally diverse groups. A recent paper by Johnson has highlighted the unique educational situation of Blacks in higher education.(90) Topics considered are the educational heritage of Afro-Americans; traditional

Black institutions of higher learning (predominantly Black colleges); Blacks on predominantly White campuses; implications of the junior college movement for Afro-Americans; Black studies; independent Black educational institutions. Efforts to use technology to aid in meeting needs of culturally diverse groups must be sensitive to the needs of those groups as they perceive them and must involve minorities in planning and implementing programs which affect their people.

d) Financing Higher Education

Higher Education represents the formal educational sector in which expenditures are growing most rapidly.* It is more expensive on a per pupil basis than elementary or secondary education. Increasingly, higher education is becoming predominantly a public sector activity, with some 75% of students enrolled in public controlled institutions. State legislatures provide substantial inputs to college revenue receipts. So does student tuition.

The financial crunch is perhaps most severe on private institutions, which in effect have stabilized their enrollments. Many are underattended compared with the space they have available, and some have been forced to close their doors. Rising tuition costs have made it increasingly difficult for all but the relatively wealthy to attend non-public institutions, thereby tending to stratify the higher educational system and to threaten, to some extent, its diversity.

The Final Report of the Carnegie Commission on Higher Education contains a number of recommendations concerned with holding down the increasing costs of higher education and with the role of the federal government.(89) Most of these recommendations are not concerned with technology utilization per se, although an earlier report by the Commission recommends federal financing to establish cooperative learning-technology centers to carry out R and D on instructional technology and to introduce instructional technology into higher education.(91)

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*From 1962-1963 to 1972-1973, total expenditures by institutions of higher education have doubled from 16 to 32 billions of 1972-1973 dollars. (86)

The overall federal role in financing higher education is quite significant. Between 1957 and 1967, the federal contribution rose sharply - from $700 million to $3.5 billion, while the state and local share declined.(91) The Commission has called for increased levels of federal government support for higher education and a variety of specific programs have been suggested.(91) However, the extent to which federal contributions to higher education will continue to grow in the future is uncertain.

e) Issues Concerning Students

A variety of student concerns include: 1) inadequate variety of courses available, 2) lack of quality in some classroom instruction,(60) 3) too much emphasis on academic subjects at the expense of relevance to life, 4) not enough variety in the educational process, 5) too much lockstep education preventing relatively easy entry and exit, etc. A major theme which emerges here is the need for more variety, more diversity, more student-initiated activity. Some new innovations in higher education such as the "University Without Walls," attempt to respond to these issues.

f) Other Issues

The Carnegie Commission on Higher Education has issued an extensive series of reports analyzing issues in higher education.(91) These reports provide a wealth of material on key issues confronting higher education.

In March, 1971, a Report on Higher Education (the "Newman" Report) was issued which was funded by the Ford Foundation.(61) This report also recommends a variety of actions to meet changing needs in higher education. Among the issues identified by the Newman Report are 1) the need to let individuals other than those of "college age" have access to higher education, and 2) the need to find new ways to go to college to combat the growing homogenization, bureaucratization, and professionalization of learning. The Carnegie studies and the Newman study both see technology as having a role in bringing about the changes they recommend.

3. Technology in Higher Education: Rationale

In the previous section on elementary and secondary education, we emphasized two primary rationales for utilizing technology in higher education, namely 1) productivity and efficiency, and 2) quality and diversity. In higher education both of these elements also require consideration. In addition, increased access and resource sharing will be explored below.

a) Productivity

Many of the considerations of productivity discussed previously in Section IIB apply here,[*] so that differences between higher, and elementary and secondary education will be highlighted. Because the average cost of a year of college education is more than twice that of a year of elementary or secondary education, presumably the potential for economies using technology may be even greater in higher education, in spite of the smaller numbers of individuals involved. The Carnegie Commission has recommended steps to reduce costs of higher education by 1980 by about 20% from those predicted by past trends. However, one of the recommendations involves withdrawal of "reluctant attenders" who constitute 5 to 12% of the college population.(81)

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[*] McClung of our research group is carrying out a study which seeks to develop educational production functions for a specific college-level course, namely accounting, taught by different methods: traditional classroom; computer-aided instruction; instructional television. Few studies of this kind appear to have been carried out.

Previously, the fact that enrollments in higher education and corresponding expenditures were projected to continue to grow substantially in the coming years meant that there would be no stabilization to take the pressure off funding sources, as has proved somewhat to be the case for elementary and secondary education. However, developments during the last two years and revised projections indicate that some easing of financial pressures and slowing down of the rate of increase of expenditures can be expected. There is more diversity in funding in higher education than in elementary and secondary education, with the students themselves footing part of the bill. There may be increased pressures to increase class size if financial constraints become severe. In effect, the closing of small, private liberal arts colleges is a manifestation of this.

Although economic pressures on private, "elite" universities would seem to favor increased technology utilization, these universities tend to be tradition-bound and more geared towards smaller classes and extensive student-teacher contact. Large state universities have used television to extend classroom instruction in basic courses to large numbers of students. These latter universities and community colleges are now the major focus of attention for large-scale educational technology demonstrations. Extensive involvement with computers for research and administration is a reality and regional computing networks are coming into being.(92) A number of surveys and forecasts predict extensive utilization of technology for instruction within the next ten to twenty years, particularly in more nontraditional forms of higher education. (See Chapter IV.)

If such increased utilization is to become a reality, some very real issues will have to be faced. New incentives will have to be provided for faculty members to develop quality courseware. Currently, the "publish or perish" syndrome limits such faculty participation. In some large universities and community colleges, collective bargaining and unionization are beginning to take hold which may limit the extent to which technology can substitute for rather than supplement teachers. Finally, it should be recognized that the technology itself may have some real limitations. For example, John Kemeny, who pioneered in the development of time-shared computing at Dartmouth, has questioned the extent to which computer-assisted instruction may be appropriate as a replacement for a book or a teacher.(62) Others may not share this view but the need for proceeding with caution to ensure that the technology is not misused in the concern over productivity and economy is clearly in order.

b) Diversity and Access

There is currently a growing movement in the U.S. towards more diversity and towards non-traditional forms of higher education. The rationale for this movement and examples of activity are contained in the recent Report of the Commission on Non-Traditional Study, entitled Diversity by Design.(63) The major recommendations of this report include:

> "1. Lifetime learning - basic, continuing and recurrent - has a new appropriateness today and requires a new pattern of support.
>
> 2. Colleges and universities must shift emphasis from degree-granting to service to the learner, thus countering what has become a degree-granting obsession.

3. Faculty understandings and commitments must be reoriented and redirected, particularly through in-service development, so that knowledge and use of non-traditional forms and materials will increase.

4. An organized effort must be made to promote intelligent and widespread use of educational technology with special emphasis on programming for cable television, computers, videotape recorders, and possibilities of satellite broadcasting.

5. New agencies must be created to make possible easy access to information and develop better ways to disseminate it, to perform guidance and counseling services, and to be assessors and repositories of credit for student achievement.

6. New evaluative tools must be developed to match the nontraditional arrangements now evolving, so that accreditation and credentialing will have appropriate measures of quality.

7. Cooperation and collaboration must be encouraged among collegiate, community, and alternate educational entities so that diverse educational programs and structures may come into being." (12)

Technology can aid in fostering this diversity. It can do this by enabling students to have access to learning resources that are not necessarily at the same location as the student. It can aid in the formation of new kinds of institutions that are not geographically bound. The scarcity of "free-access" colleges cited by Willingham(59) and the imposing numbers of new institutions called for by the Carnegie Commission(58) may be strongly affected by the extent to which communications technology can make inroads into higher education. Here the British experience with the Open University and other such experiences are particularly relevant.(64) Although TV and radio broadcasts may occupy a relatively small percentage (about 10%) of the student's learning time, they represent an integral element of the "outreach" aspect of the British Open University which begins to weaken some of the geographical restrictions previously imposed on higher education. The development of the Open University of the State of Nebraska and the new University of Mid-America will provide an important test of the feasibility of a television-based Open University in the United States.(19A)

A word of caution is required at this point concerning the role of technology in non-traditional higher education. Wong concluded that technology was having relatively little impact on those non-traditional institutions surveyed by the Commission on Non-Traditional Study.(19A) Although many of these institutions used audiotape cassettes, most innovative aspects of these non-traditional programs tended to be non-technological. Demerath and Daniels tend to support this conclusion in their case study of the use of technology in four different types of institutions of higher education.(19) Wong did find, however, a growing number of technology-based networks delivering televised lectures to off-campus locations.(19A)

The issue of access is also related to productivity or economy in higher education. Bowen(65) has roughly estimated a cost per student of $1,675 for non-traditional U.S. higher education structured with some telecommunications component. This is less than the average cost per student which Bowen estimates to be about $2,127 in public colleges and universities and about $2,731 in private universities in 1971-1972.

This raises the interesting issue of whether or not to charge the off-campus student more than the traditional on-campus student. A study by Morris, et al.(92) of continuing professional engineering education off-campus via television indicates that off-campus students in this instance are charged the same rate as on-campus students, with their industrial sponsors paying additional costs for the televised service. Off-campus incremental costs for three such networks are estimated to be less than on-campus costs, although methods for performing such cost comparisons may need refinement.(19A)

c) Resource Sharing

Smaller institutions which cannot now afford or do not have access to certain expertise, course subjects, library materials, and computer time and programs may be able to share resources with other institutions by using telecommunications. Regional libraries, computing networks, and TV networks are in operation which do provide some of these services to a growing number of institutions on a limited basis. It might even be possible to provide the kind of peer matching and skills matching of individuals that Illich(66) talks about via computer-communications links. However, the latter seems a much less probable development than resource sharing within an institutional framework. Specific resource sharing arrangements involving technology are discussed in Section IIC4d.

4. Large-Scale Electronic Technology: Selected Uses in Higher Education

a) Introduction

In this section, selected uses of telecommunications technology in higher education are described. Included is a fairly detailed synopsis of experiments performed or planned involving communications satellites. The fairly extensive discussion of satellites and higher education at this point reflects our perception that this educational sub-sector is one of the more promising for increased large-scale technology utilization, based in part upon experience to date and activity planned for the future. More details concerning the various technologies and telecommunications services themselves can be found in Chapter III.

b) Television

Television has been used in higher education in a variety of ways. Initial efforts included the "Continental Classroom" broadcasts carried on commercial networks during early morning hours, closed circuit TV used for teaching large enrollment courses in large state universities, and the "TV college" idea as implemented by Chicago TV College since 1956. The latter is an early example of the use of broadcast television to transmit college level instructional programs for degree-credit directly to homes and other institutions.(94) Project Surge at Colorado State University has made extensive use of videotapes to offer engineering courses at industrial, off-campus locations.(67)* Stanford University uses "talkback" television to reach industrial locations via ITFS.(68)

Wong has completed a study of the role of technology in non-traditional higher education.(19A) As part of that study, he gathered information on some 26 technology-based networks which join geographically separate and distinct locations to deliver instruction beyond the confines of a single campus by means of communications technology. (See Table 3A.) Most of these networks deliver televised lectures to off-campus locations by means of a variety of transmission media: ITFS, point-to-point microwave, broadcast TV, mailing of videotapes. Some of the systems are audio only and a few use a more limited visual media, the electrowriter. A major audience for these networks has been engineers and other professionals at industrial locations, although a variety of other uses in higher education have been instituted.

Recently, television in higher education has been receiving increased attention as a result of the success of the Open University in Great Britain.(95) That institution was designed to provide increased access to higher education in Great Britain by means of a correspondence-based university which

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*See Section IIF for additional discussion of Continuing Professional Education.

Table 3A. Typology and Listing of Technology-Based Networks (from Ref. 19A)

Videotape Networks

Colorado State University including programs SURGE, Co-TIE, and other off-campus activities
The Iowa State University Videotape Program
Other Videotape Programs

ITFS Instructional Television Networks

The Stanford Instructional Television Network (SITN)
The University of Southern California Instructional Television System
The University-Industry Television for Education (UNITE) of the University of Minnesota
Case Western Reserve University Instructional Television Network of Ohio
Other ITFS Instructional Television Systems

Point-to-Point Microwave Television Systems

The Association for Graduate Education and Research of North Texas (TAGER)
The Indiana Higher Education Telecommunications System
The Oklahoma Higher Education Televised Instruction System
The Michigan Expanded Resources for Graduate Education of the University of Michigan
The University of Rhode Island Instructional Television System
The Ohio State University Instructional Television System
The University of Connecticut Television System
The University of California-Davis Instructional Television System
The University of South Carolina Instructional Television System

Broadcast Television Networks

The T V College of Chicago
The Maryland Center for Public Broadcasting
The Miami Dade Junior College of Florida
The Kentucky Educational Television Network
The State University of Nebraska--Project SUN
Other Broadcast Television Networks

Other Instructional Television Networks

The City University Mutual Benefit Instructional Network of the City University of New York (CUMBIN)

Educational Telephone Networks

The University of Wisconsin Educational Telephone Network
The Kansas Statewide Continuing Education Network
The Virginia Polytechnic Institute Multi-Media System

Electrowriter Networks

The University Extension Network (UNIVEX-Net) of the University of Illinois
The University of Tennessee Electrowriter Network

reaches out to homes and learning centers. A complete campus has been developed at Bletchley, England, at which there are no students. Instead, an extensive faculty and professional effort to design and disseminate instructional programs is carried on there. Television is an integral component of the British Open University but is by no means the only instructional medium used. A small number of U.S. universities have been experimenting with British Open University program materials.

A substantial number of "open university" or "external degree" programs have either been started or are reported to be in various stages of planning in various statesin the United States.(96) Among these is the State University of Nebraska (SUN) Project, supported by the National Institute of Education, which is planning to develop an extensive "open university"-type operation in the State of Nebraska using televised instruction.(97) On July 20, 1974, four other large midwest universities (University of Kansas, Kansas State University, University of Missouri and Iowa State University) joined the University of Nebraska in forming the University of Mid-America (UMA). This new university will be a regional open learning institution that makes college-level courses available to people in their homes. According to the Chairman of UMA State Universities Association, "The University of Mid-America is another example of how interinstitutional and interstate cooperation can provide improved services and educational opportunities at minimum cost to the taxpayers and the people they serve."(98)

Although UMA will not award degrees at this time, its significance lies in the possibilities for resource sharing in the development of programming and in getting sufficient audiences for costly television programs so that per student costs are reduced to acceptable levels. Furthermore, the outcome of this development in regionalization has major implications for future satellite utilization which will require a regional or even national base to achieve desired economies of scale. UMA will be headquartered at Lincoln, Nebraska, site of the Great Plains National Instructional Television Library (GPNITL), one of a small number of institutions which have attempted previously to serve as a focal point for development and dissemination of instructional programming on a nationwide basis but which appears to have focussed more on elementary and secondary education and to have had little impact in higher education. GPNITL duplicates and disseminates videotapes.

Two additional developments moving towards regional and/or national resource sharing involving television are worth noting. First, a Public Service Satellite Consortium has been formed to explore delivery of educational, health and other public services via satellite, with considerable involvement of representatives from higher education.(307) Second, a Task Force on Post Secondary Education of the Advisory Council of National Organizations of the Corporation for Public Broadcasting is examining the future role of CPB in this educational sector.

c) Computers for Instruction

Extensive use of computers by colleges and universities began in the early 1960's and has grown rapidly.* Various uses of computers at all levels of education, including higher education, are depicted in Figure 2. For higher education, computer utilization (1966-1967) is distributed as

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*A major source of information on uses of computers in higher education is a book by Levien. (99)

	Instructional Applications of Computers					Administrative Applications of Computers				Research Applications of Computers								Library Applications		
	Instruction about Computers			Instruction with Computers						Research on Computers			Research with Computers							
	Specialist Instruction	Service Instruction	Survey Instruction	Computer Assisted Instruction/ Computer Based Instruction/ Computer Managed Instruction	Computer Assisted Problem Solving	Computerized Financial Operations	Computerized Personnel Management	Computerized Program Management	Computerized Facility Management	Hardware Oriented Research	Software Oriented Research	Research on Theory and Science of Computing	Number Processing	Symbol Processing	Data Processing	Event Processing	Picture and Sound Processing	Circulation Automation and Computer Aided Cataloguing	Computerized Indexing and Retrieval	Computer Aided Vocational Guidance
Elementary Schools				X		X	X	X	X						X					
Secondary Schools			X	X	X	X	X	X	X						X					X
School District						X	X	X	X						X			X		
Vocational Schools	X		X	X		X	X	X	X						X					
Community Colleges	X	X	X	X	X	X	X	X	X						X					X
Colleges	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	
Universities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

*from Ref. 11

Figure 2. Computer Applications in Education*

follows: for research - 40%; for instruction - 30%; for administration - 28%; other - 2%. Expenditures on computer activities by institutions of higher education in the U.S. rose more than sevenfold from 1962-1963 to 1968-1969, with 351 million dollars being spent on computing activity in the latter year.(100)

Larger schools and those granting higher degrees have greater access to computing facilities than smaller schools and those that do not grant advanced degrees. In 1967, the President's Science Advisory Committee (PSAC) recommended some 20 minutes of computer time per student per year as a goal for computer usage in higher education. However, about one-half of the nation's colleges and universities were estimated to be entirely without computer services as the 1970's began.(5) Kerr stated in August, 1972, that approximately 25% of students now enrolled are at campuses that have no computing facilities.(101)

Much computer instruction in higher education is "about" computers rather than "with" computers. The former is concerned with educating individuals to be knowledgeable about computers and to use computers, in view of their current and ever increasing significance to our society. The latter is concerned with using the computer to aid and abet both teachers and students in the educational process. The terms "computer-assisted instruction" (CAI), "computer-based instruction" (CBI), "computer-managed instruction" (CMI) fall within this latter category (See Chapter III.) Comstock has categorized computer participation in the instructional process by: 1) performance uses, in which the computer assists in the performance of some step in the teaching or learning process, 2) management uses in which the computer assists in clerical functions of recording, testing and prescription, and 3) comprehensive uses which span 1) and 2).(100) To date, most activity involving instructional uses of computers in higher education is about computers rather than with computers. However, much attention has been devoted of late to instruction with computers.

In spite of strong feelings both for and against the use of computers in instruction, the computer appears to be finding widespread use in higher educational instruction, but not usually in the form of computer-implemented programmed instruction. Comstock reports that even in the humanities, arts and social sciences, experiments in computer-based instruction are underway and that the computer rarely substitutes for the instructor but supplements and amplifies his or her role.(100)

Recently, efforts to develop computer-based instruction systems for higher education have been initiated. The U.S. National Science Foundation is currently funding two major CAI demonstrations; one using the large and highly centralized Plato-IV system (Programmed Logic for Automatic Teaching Operations) developed by the University of Illinois, the other the TICCIT (Time-Shared, Interactive, Computer-Controlled Information Television) system developed by the MITRE Corporation.

Plato-IV is designed to serve ultimately 4,000 specially designed terminals with a plasma display panel and with memory provided by a centrally located single large computer. It is projected that such a system would cost $0.34 per student contact hour if costs are amortized over 5 years and it is assumed that the system is used 8 hours a day for 300 days a year.(52) The Plato approach has stressed teacher involvement in preparation of courses and many professors and students at the University of Illinois, which pioneered in the development of the Plato system, have used the facility. Terminals are being installed in junior colleges in the Chicago area and courseware is being developed for several basic junior college courses spanning a variety of topics.

In contrast to the large computer approach of Plato-IV, the TICCIT system connects a smaller computer to home television sets via coaxial cable, using the TV set as a display device, a "frame-grabber" for displaying still pictures, and a response pad for student interaction.(43) Hardware costs for a system with 128 terminals are estimated at $450,000 with somewhat lower costs ($300,000 to $400,000) expected if the system is widely used. In contrast to the original Plato-IV approach which was experimental, an attempt is being made from the outset to develop courseware which could be used widely in beginning algebra and math courses at the community college level. Courseware is being developed at Brigham Young University and will be used at Northern Virginia Community College and Phoenix Community College.

Cost projections for both Plato-IV and TICCIT indicate that fully operational systems will provide instruction at less than the costs of traditionally-administered (teacher) instruction. Should these projections be realized, these systems may have a substantial effect on the future of higher education in the United States, particularly at the community college level to which initial demonstrations are directed, but possibly at other levels as well. Research is underway at the Center for Development Technology to explore technical and economic feasibility of delivering Plato-type CAI to regional or national users via satellite.

d) Computer and Information Networks

During the period from 1968-1972, the U.S. National Science Foundation funded the establishment of some twenty-five experimental regional computer networks. Figure 3 indicates the approximate location of these networks. The advantages of participating in such a network cited by Weingarten et al.(69) are: 1) the efficiency and variety of computer services and 2) the economy of sharing such a system. Generally, such a network ties a number of smaller institutions to a larger institution. For example, Dartmouth College, a pioneer in university computing, serves one university, one community college and seven undergraduate colleges.

A recent article by Greenberger, et al.,(70) documents a movement in research and education towards regional and national resource sharing via networks. The benefits of such sharing include:

> --"Greater variety and richness of available resources and more flexible intermingling of information with computing services.
>
> --Widened availability of resources to all institutions regardless of size, location or financial status.
>
> --Decreasing cost per unit of information stored or processed because of increasing economies of scale and expanded sharing.
>
> --Payment for information processing as it is obtained with virtual elimination of the capital costs and budgetary uncertainties currently characteristic of autonomous information and computer center operations."

A major national computer network is ARPANET, developed by the Advanced Research Projects Agency of the Department of Defense (see Figure 4). The ARPANET system interconnects large and specialized computing facilities, many in universities, across the United States. ARPANET permits sharing of specialized and expensive-to-duplicate hardware and software by about 30 major computers on the U.S. mainland linked by 50 landlines and is now linked to Hawaii via satellite.(71)

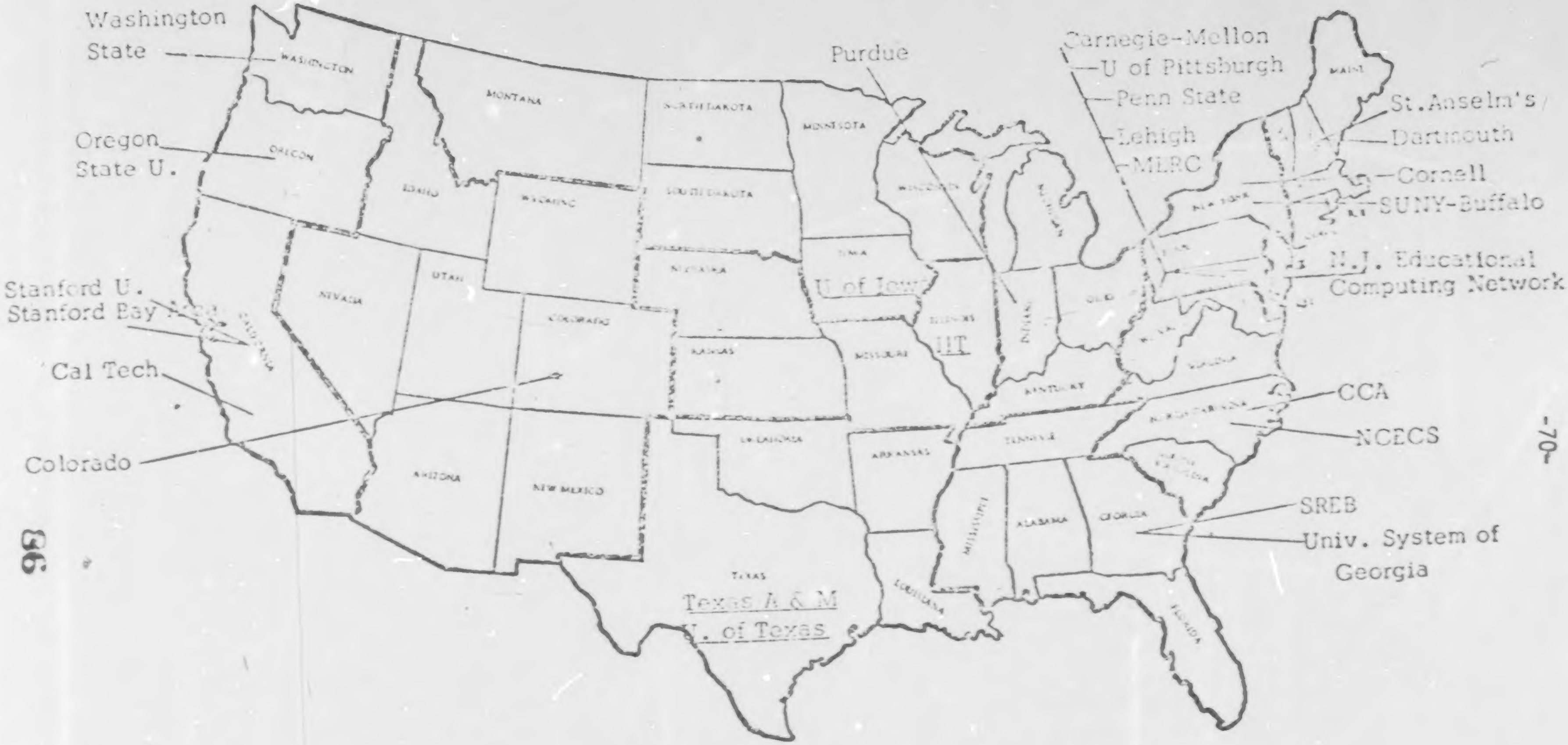
Washington State
Oregon State U.
Stanford U.
Stanford Bay
Cal Tech
Colorado
Purdue
U of Iowa
IIT
Texas A & M
U. of Texas
Carnegie-Mellon
U of Pittsburgh
Penn State
Lehigh
MERC
St.Anselm's
Dartmouth
Cornell
SUNY-Buffalo
N.J. Educational Computing Network
CCA
NCECS
SREB
Univ. System of Georgia
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
NEW YORK
MAINE

Figure 3: Approximate Location of 25 Networks Established with NSF Support*

*From Ref. 69

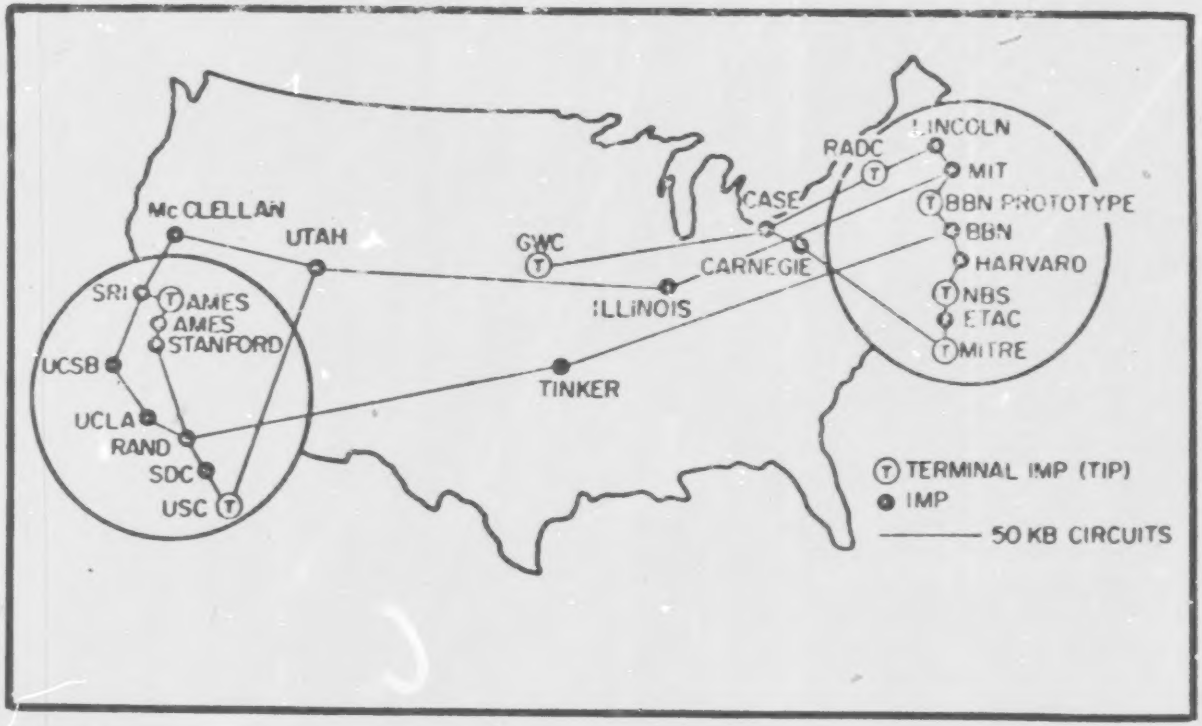
Mc CLELLAN
UTAH
SRI
Ⓣ AMES
AMES
STANFORD
UCSB
UCLA
RAND
SDC
USC Ⓣ
GWC Ⓣ
ILLINOIS
TINKER
CASE
CARNEGIE
RADC Ⓣ
LINCOLN
MIT
Ⓣ BBN PROTOTYPE
BBN
HARVARD
Ⓣ NBS
ETAC
Ⓣ MITRE
Ⓣ TERMINAL IMP (TIP)
● IMP
50 KB CIRCUITS

Figure 4: ARPA Network, Geographic Map, March 1972*

*from Ref. 71

Networks have also been developed for a variety of other uses. NSF is supporting development of regional systems for science information, including one focussing on chemistry and biology in Georgia. A network has been developed to provide on-line shared cataloging services for 48 colleges and libraries in Ohio by the Ohio College Library Center and is being extended to other states. Medline, a service of the National Library of Medicine, provides both national and international on-line search and retrieval of the medical literature cited in Index Medicus.

The extent to which networks will gain acceptance would appear to be affected by a number of factors. Among the technological trends which Greenberger, et al.(70) see as beginning to alter the organization of research and education computing services are:

1. The development of powerful, popular minicomputers.
2. Increasing acceptance of remote computing via either time-sharing or remote job entry.
3. Improvements in computer communications technology, data transmissions and switching procedures which are making "networking" easier and less costly.
4. Development of large, inexpensive computer memories, tending to favor centralized information storage.

Although some of these trends would appear to be contradictory, Greenberger, et al. see them giving the computer user more freedom from the local computing center and more options. Harvard is cited as an example of a university which gave up its large central computing facility and which is searching nationally for the best service available for each application.(70)

There are clearly some constraints on the development of computer and information networks. Whereas ideally, it might be desirable for colleges and universities to have access to both centralized time-shared computers for certain applications and campus minicomputers for others, financial constraints are ever present. Levien has pointed out that for most instructional materials, minicomputer capabilities will be adequate.(99) Although time-shared computing services might appear to be potentially more cost-effective than minicomputers, the increased complexity of a larger-scale operation requires greater administrative effort, managerial ability and interinstitutional cooperation. Both Levien(99) and Weingarten(70) discuss these issues in some detail.

e) Communications Satellites

(i) Introduction

The history of experiments with satellites for educational communications in the U.S. dates back to January 4, 1970, when the Corporation for Public Broadcasting (CPB) initiated an experiment in transcontinental interconnection employing NASA's Applications Technology Satellites 1 and 3. The objectives of this experiment were technological, the primary one being the evaluation and optimization of a transcontinental satellite link between the East and West Coast for video interconnection using medium sized receivers (30-40 foot antennae) in an urban environment. Since then a number of educational communications demonstrations and experiments using ATS-1 and 3 satellites have been completed or are continuing (see Table 4). With the sole exception of the CPB transcontinental interconnection experiment conducted using C-band (4 and 6 GHz) transponders, experiments continuing or completed to date on ATS-1 and 3 have employed Very High Frequency (VHF) transponders, using frequencies that are not assigned for operational services and that are incapable of accommodating wideband or high-data rate

Table 4: Applications Technology Satellite Educational Communications Experiments

Completed	Concluded	Spacecraft	Purposes
Corporation for Public Broadcasting	March 1970	ATS 1, 3	Transcontinental Interconnection
Stanford University	June 1972	ATS-3	Computer-Assisted Instruction Delivery to Rural Areas.
Continuing	Started		
State of Alaska (National Library of Medicine, National Public Radio, and U.S. Office of Education)	June 1970	ATS-1	Educational/Instructional Radio; Teacher Training
University of Hawaii	March 1971	ATS-1	Pacific Interconnection of Institutions of Higher Learning
DHEW/CPB/NASA (Alaska, Appalachia, and Rocky Mountain States)	June 1974	ATS-6 ATS 1, 3	ETV Distribution and Limited Interactive Services
Approved	Estimated Start		
India/NASA	Summer 1975	ATS-6	ITV Broadcasting
Conditionally Approved			
A Number of Proposals for Experiments Using CTS	Winter 1975	CTS	Dental education; Inter-college Resource Sharing; Document Delivery; Library Resource Sharing

communications such as television relay/distribution. The experiments conducted to date on VHF involve delivery of Computer-Assisted Instruction (CAI) to rural areas; lecture, seminar and data exchanges among institutions of higher learning; and, delivery of educational/instructional radio for public education and teacher development.

On May 30, 1974 the ATS-F (now ATS-6) satellite was successfully launched into geostationary orbit. This satellite, which will be used for carrying out a variety of educational experiments in a variety of locations, represents a significant increase in technological capability for educational satellite utilization. Some satellite experiments pertinent to higher education will now be discussed. (See also Polcyn, Ref. 299.)

(ii) The PEACESAT Project

The stated purpose of the PEACESAT Project (Pan Pacific Education and Communication Experiments by Satellite) is to demonstrate the benefits of currently available telecommunications technology when applied specifically to the needs of sparsely populated, less industrialized areas of the world. The project, initiated by the University of Hawaii, provides an "intercontinental laboratory to develop improved communication methods of education, health and community services in the Pacific and a base for long range planning."(72)

The educational communication satellite system portion of PEACESAT has been operating and under development since April 1971 and uses NASA's ATS-1 satellite. The system utilizes low cost ground stations with both receive and transmit capability. These terminals, costing about $7,000 each, permit two-way voice and xerox facsimile from all locations. Some locations will have slow-scan TV and teletype capability.

A pilot educational satellite system linking Hilo (Island of Hawaii) and Honolulu (Oahu) began operating in April 1971 and is claimed to have offered the first college course taught via satellite, the first satellite interconnection for library networking and the first intrastate satellite network in the U.S. In January 1972, universities of other countries were added to the system. According to PEACESAT literature, time zone differences and language and dialect differences have not been a problem.(72)

As of February, 1972, ground terminals had been established at the University of Hawaii-Manoa Campus (Island of Oahu); Hawaii Community College Campus and Hilo College (Island of Hawaii); Wellington Polytechnic Institute at Wellington, New Zealand; and the University of the South Pacific at Suva, Fiji. Ground terminals were also being test operated or planned for a variety of other locations in the pan-Pacific area.

In June, 1971, two classes, Speech 150 in Hilo, Hawaii and Speech 145 in Manoa Campus, Oahu, participated in joint activity via satellite. Students engaged in game activity, using two-way voice communication. Facsimile transmissions were also used. Activities concentrated upon included intelligibility, problem solving, information gain, communication of feelings, and determining attitude from speech expression. An important aspect of this experiment was the use of interactive, two-way communication which is deemed of particular importance in interuniversity cooperation of a cross-cultural or trans-national setting.

Other university level uses include teleconferencing and instructional exchange among widely scattered participants in such subjects as political science, geography, English as a second language, Spanish, Indonesian, communication and teacher education. Subjects of mutual interest discussed by participants have included student government, Pacific Island broadcasting, foreign investment, race relations and ethnic studies. Special projects dependent upon the system are developing including a student newspaper news exchange, a non-commercial radio news service, and international debates on subjects such as tourism.

Other uses of the system have included the transmission of library materials from one campus in Hawaii to another which has appreciably speeded up service. Formerly, Hilo faculty wishing Hamilton Research Library materials waited three to nine weeks for the materials to arrive. Using PEACESAT, orders are transmitted over the system via facsimile (xerox). Magazine articles are delivered over the system within 48 hours and books by mail within 96 hours. The service was to have been extended between the University of the South Pacific and Hawaii.(72)

PEACESAT has also been used for communication related to research to combat starfish invasions and disease epidemics, for medical consultations concerning infectious diseases, by the Hawaii Agricultural Experiment Service to conduct seminars with its offices and agents, and to broadcast the investiture of the Chancellor of the University of Hawaii.

The guidelines for requests for use of PEACESAT are interesting. They include:(72)

"1. The request must be a joint request. The more locations involved in the service the better.

2. Any planned exchange should require the use of instant two-way communication. If a project can be equally well served through use of other communication facilities, those other facilities should be used rather than PEACESAT.

3. The use should be a benefit to each institution participating in the exchange. PEACESAT is not designed for one-way information dissemination.

4. The project should have a definite education or social purpose.
5. All projects must be strictly non-profit. Only non-profit organizations and institutions may use the system.
6. In general, new kinds of uses have preference. Evaluation of results is encouraged. And pilot projects which demonstrate long range social improvement are sought."

(iii) The ALOHA System

Paralleling the development of the PEACESAT system has been another development at the University of Hawaii which gives promise of providing computer-communication inputs to communication satellite transmission. In September, 1968, the University initiated a research program to investigate the use of radio communications for computer-computer and console-computer links. The remote-access computer system - The ALOHA System - being developed as part of that program is planned to link interactive computer users and remote-access input-output devices at community colleges and research institutes away from the main campus of the University of Hawaii to the central computer via UHF radio communication channels.(73)

The ALOHA System is also actively pursuing the possible development of a Pacific Educational Computer Network using wide-area satellite channels in the "packet communication" mode to permit sharing of specialized computing resources and low-cost utilization of computers located in differing time zones during off-peak hours.(74) In January of 1973 a planning meeting was held at the University of Hawaii for such a Pacific Educational Computer Network. At that meeting, experience to date in extending the ALOHA System via satellite was described. In December 1972, a digital communication subsystem involving a single 50 kilobit satellite channel was installed between the COMSAT ground stations at Jamesburg, California and Paumalu, Hawaii.

The first subscriber of this service was the ALOHA system which became the first operational satellite node of the ARPANET.* The lease cost of the channel, including ground links, is about $10,000 per month, which even taking into account projected cost decreases does not appear feasible for a large Pacific network.(74) However, if the full-duplex 50 kilobit channel could be used to connect a larger set of ground stations in the Pacific, then it could be used by any earth station which views INTELSAT IV. Regulatory barriers need investigation.

The second ALOHA satellite project involves use of the ATS-1 satellite and small ($5,000) ground stations to operate a random access burst mode data channel between the University of Hawaii and NASA/Ames Research Center in California. Plans called for the University of Alaska to join this network in 1973 and for extension of this network on an experimental basis to ground stations in other countries.

In January, 1974, a second planning and review meeting was held for the Pacific Educational Computer Network experiment.(103) Topics of discussion included the use of satellites and the use of ARPANET as a resource in the Pacific network experiment. Technical and policy issues related to future international network development were discussed. Studies have also recently been completed of educational computing in the Pacific Rim(104) and organizational alternatives for a Pacific educational computer communications network.(105)

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*ARPA has a satellite task force in which many U.S. universities are participating to explore techniques for using wide-area satellite channels for computer-communications and to investigate the economics of satellites for computer interconnection.

(iv) Teaching Techniques for Rural Alaska

A 1972 NEA-UNESCO study recommended an in-service project using a communications satellite to overcome the isolation and lack of terrestrial communication among teachers in rural Alaska. The purposes of this experimental project were:(75)

> "1. To demonstrate the feasibility of using satellite communications as a vehicle for increasing the professional competencies of teachers in selected remote isolated villages of Alaska.
>
> 2. To demonstrate the effectiveness of transcontinental satellite interconnections between two or more widely separated points to deliver information and obtain feedback and interaction between those points.
>
> 3. To stimulate the University of Alaska to use satellite communications in expanding professional growth opportunities for teachers in remote villages, in so doing, to make use of resources not otherwise available."

Beginning on January 22, 1973 the National Education Association in conjunction with its State affiliates, Alaska-NEA and the College of Education, University of Alaska, conducted a 16-week satellite radio series with teachers in 17 Alaskan villages. Teachers could take the course, which was coordinated by the Rural Teacher Corps Project, for one credit in the College of Education. NASA's ATS-1 satellite was used along with the National Institute of Health (NIH) satellite uplink and studios in Bethesda, Maryland outside Washington. Villages could talk to villages as well as to the University of Alaska and three NEA staff members at Bethesda. Six persons took the course for credit and others audited.

The satellite seminars, which featured two-way voice interaction, covered topics listed in Table 5. Evaluation of the overall program was generally favorable.(75) The satellite was also used to provide emergency diagnosis of medical problems during this period.

Table 5.
Satellite Seminar Schedule, Spring 73*

January 22	"Open Classrooms: Suggestions on How to Get Going". Dr. Robert McClure, NEA, Washington, D. C.
January 29	"Open Classrooms in Rural Alaska" Mike DeMarco, CNER, University of Alaska
February 5	"Self Responsibility and Learning" Sandy Hamilton and Bob Maguire, ASOS, Allakaket, Alaska
February 12	"Children as Teachers" Gaylen Searles, Alaska Rural Teacher Training Corps, University of Alaska, Fairbanks
February 19	Holiday
February 26	"Non-Graded Approach in Tanana" Eileen Crooks, ASOS, Tanana Ann Howard, ASOS, Tanana, Rudy Howard, ASOS, Tanana Max Meeker, ASOS, Tanana, Judy O'Donnell, ASOS
March 5	"New and Pending Legislation Affecting Rural Schools" Bob Cooksey, NEA-Alaska, Juneau Dr. Marshal Lind, Commissioner of Education, Juneau Senator Terry Miller, President of the Senate, Juneau Dr. Helen Beirne, Chairman of House, Health, Education and Welfare Committee, Juneau
March 12	Continuation of February 26 presentation, plus: "Problem Learners in the Non-Graded Classroom" Mary Moses - ASOS, Tanana
March 19	"This Works for Me" Karen Clark, Alaska Teacher of the Year, Two Rivers
March 26	"Language and Learning in Rural Alaska" Dr. Michael Krauss, Alaska Native Language Center, University of Alaska
April 2	Continuation of March 26 presentation
April 9	"Effective Teachers of Indian and Eskimo Students" Dr. Judith Kleinfield, Center for Northern Education Research, University of Alaska
April 16	"Views from a National Perspective" Mrs. Cartherine Barrett, President, NEA Rep. Don Young Dr. Harold Wigren, NEA, Washington, D.C.
April 23	"Teaching Strategies for Rural Alaska" Dr. Charles K. Ray, College of Behavioral Sciences and Education, University of Alaska
April 30	"Community Involvement in Education" Jim Williams, ASOS, Ft. Yukon Carolyn Peter, ASOS, Fr. Yukon Bill Pfisterer, ARTTC, Ft. Yukon
May 7	"Emerging Trends and Issues in Rural Alaskan Education" Dr. Frank Darnell, Center for Northern Educational Research, University of Alaska
May 8	Final Evaluation Session

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[*] from Ref. [27].

A set of experiments are also being carried out to determine the technical feasibility of transmitting medical information via ATS-1, with low-cost small earth stations.(76) This project, being sponsored by the Lister Hill National Center for Biomedical Communications, involves the Universities of Wisconsin, Stanford University, and the University of Washington, Seattle.

The above experiments have permitted interactive communication with voice and digital data only. These limitations are imposed by the relatively low power and small channel capacity of the ATS-1 and 3 satellites. These satellites, now well beyond their design lifetimes, have been joined by the ATS-F (ATS-6) satellite and are to be joined shortly by the CTS satellite. These latter two satellites will permit expanded activity of a type now to be described.

(v) The Health-Education Telecommunications Experiment*

The Health-Education Telecommunications (HET) experiment, jointly sponsored by NASA, the Department of Health, Education and Welfare, (DHEW), and the Corporation for Public Broadcasting (CPB) involves educational experiments in Alaska, Appalachia, and the Rocky Mountains. The experiment, which began with a satellite launch on May 30, 1974, employs the ATS-F (now designated ATS-6) satellite to distribute health and educational material to public broadcasting stations, cable television headends, translators and community centers in S-band (2500 MHz) using low-cost/receive terminals ($3,300-$3,500 per unit in quantities of 100 or so). It uses VHF transponders onboard the ATS-1 and 3 spacecrafts to accommodate limited narrowband interaction (voice or low-speed data/facsimile) from selected remote installations. Figure 5 shows the communications

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*A good source of additional, current (as of end of 1974) information on this subject is an article by Grayson.(308)

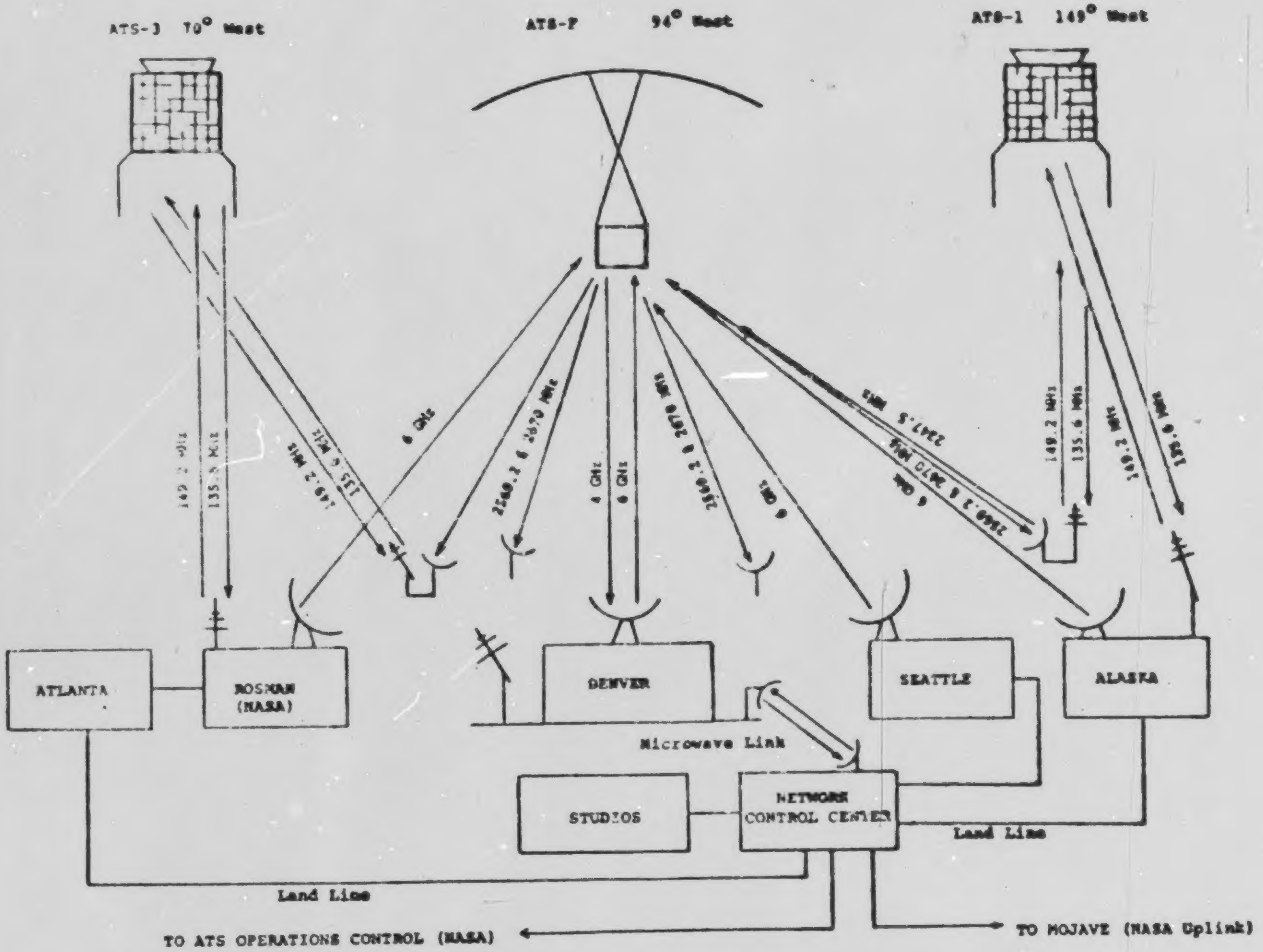
ATS-3 70° West
ATS-F 94° West
ATS-1 149° West
149.2 MHz
135.6 MHz
149.2 MHz
135.6 MHz
6 GHz
2569.2 & 2670 MHz
4 GHz
6 GHz
2569.2 & 2670 MHz
6 GHz
2247.5 MHz
2569.2 & 2670 MHz
6 GHz
149.2 MHz
135.6 MHz
149.2 MHz
135.6 MHz
ATLANTA
ROSMAN (NASA)
DENVER
SEATTLE
ALASKA
Microwave Link
STUDIOS
NETWORK CONTROL CENTER
Land Line
Land Line
TO ATS OPERATIONS CONTROL (NASA)
TO MOJAVE (NASA Uplink)

Figure 5: The HET Communications Network*

*from Ref. 77

network for the HET experiment.(77)

The HET experiments are planned to explore, in addition to demonstrating the feasibility of distributing ETV signals to low-cost terminals, the three dimensions of educational delivery arrangements - the hardware, software, and human-support elements. These are to be weighted in different ways to assess the impact of different combinations on the learning, participation, and opinions of the program-receiving audience. The programming is to focus upon career education, and in-service teacher development. The total cost of the entire experiment exclusive of the space segment is estimated to be in the range of $11-12 million.(23)

The scale, duration and funding support of HET experiments and the technology involved, with particular respect to ETV distribution in S-band to low-cost terminals, make it the first true demonstration of the capabilities offered by high-power satellites even if it touches upon only a few of the opportunities that satellites potentially may provide.

Higher education's participation in the HET experiment will be somewhat limited. In the Rocky Mountain area, in-service training sessions for teachers are carried out using one-way video, two-way audio and digital interaction.(78) During the summer of 1974 the University of Kentucky initiated a graduate teacher training project with the satellite, involving teachers at regional education service agencies in ten Appalachian states.(78) Alaska's participation in the HET experiment is currently directed towards elementary school students. The NEA is also interested in continuing its efforts directed towards professional development of teachers in Alaska through use of ATS-6.(31)

The ATS-6 satellite will be available over the U.S. for one year. It will then be positioned so as to view the Indian subcontinent for purposes of carrying out SITE, the Satellite Instructional Television Experiment. Details of this experiment involving family planning, improved agricultural practices, national integration, general school education and teacher training, are described elsewhere.(79, 80)

One should bear in mind that ATS-6 is not a spacecraft designed exclusively for S-band communications for U.S. domestic applications but it is more like a bus that carries onboard a number of other communications and scientific packages. In fact, 2500 MHz S-band transmitters for the HET experiment were a late addition to the ATS-6 payload and the lateness of the proposal inhibited efforts to tailor antenna footprints for optimum coverage of the regions involved. The complications involved in providing for interactive communications, simultaneous coverage of all the regions, and interregion communication are well illustrated by Figure 5.

In brief, the HET experiment is the first major U.S. educational experiment that will provide valuable information for structuring educational telecommunications networks and, in particular, determining the role of communications satellites vis-a-vis other technologies in such networks. But the information provided by one year's experience with limited satellite time and capabilities will certainly not be sufficient to resolve all the questions that stand in the way of developing operational telecommunications-based networks/delivery systems. The HET experiment represents only the first step of an iterative process that leads to policy determination and the possible development of operational systems.

(vi) Communications Technology Satellite

Communications Technology Satellite (CTS), a Canadian program in cooperation with NASA, is to be launched in December of 1975. Like ATS-6, it contains a high-power transponder which allows use of inexpensive and small earth terminals, but in the Ku-band (12 and 14 GHz). A number of proposals for user experiments with CTS have been submitted by a variety of U. S. organizations and institutions to NASA. These include the delivery of Computer-Assisted Instruction (CAI), interinstitutional and inter-regional resource sharing, and experiments with new arrangements for the delivery of educational services, both within and outside the framework of the traditional college/university setting.

As of August, 1974, conditional approval had been given by NASA for several experiments on CTS, some involving higher education. Stanford University and Carleton College, with the assistance of NASA-Ames Research Center, will use two-way digital video to demonstrate curriculum sharing between two institutions, one of which has an engineering school and one of which does not. The Division of Dental Health of the Dental Health Center of NIH, aided by NASA-Ames, will deliver video lectures, video oral surgery demonstrations, and computer-aided-instruction to several dental schools and other participating institutions scattered throughout the U. S. The Federation of Rocky Mountain States will carry out a follow-on experiment to their ATS-6 involvement.

In addition, conditional approval has been given for two experiments involving document delivery and library resource sharing. The New York State Education Department, through the New York State Library, will carry out a project in which a prototype facsimile network for document delivery will serve geographic areas spanning the U.S. The project will test the utility of the facsimile medium of "electronic page turning,"(107) using facsimile equipment that will be capable of transmitting a page directly from a bound volume, in a network arrangement. The material to be transmitted will be of primary interest to medical researchers and practitioners, legislators, researchers and businessmen. Network control will be centered in Albany, New York. A library resource sharing experiment, SALINET, will also be carried out centered at the Graduate School of Library Science at the University of Denver.

(vii) After ATS-6 and CTS?

In January, 1973, NASA decided to phase out its communication satellite R and D program and to cancel the launch of the ATS-G program which was to follow ATS-F. Cancellation of the ATS-G launch eliminated the back-up for ATS-F, in the event ATS-F did not reach its orbit successfully or failed in orbit. Fortunately, the launch was successful. However, cancellation of ATS-G also eliminates the alternative of continuing the HET experiment beyond one year without any major change in the ground segment implemented for experimentation using ATS-F. Communications Technology Satellite (CTS), a joint U.S.-Canada program, is to be launched in the winter of 1975 and provide the only avenue now definitely firm for continuing HET experimental programs and initiating new ones.* However, CTS, although

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*At the time this report was prepared, there was some discussion of possible initiatives which, if implemented, would change this situation. One was the possibility of getting funding for an ATS-F "prime" follow-on to ATS-F, using existing prototype equipment available from ATS-F development. The other hinged upon getting a domestic satellite operator to place a 2.5 GHz transponder aboard one of the DOMSATS soon to be orbited. Yet a third possibility to consider is the use of ATS-F after the Indian SITE experiment is concluded.

designed to serve low-cost terminals, is to operate in the Ku-band (12 GHz down-links and 14 GHz up-links) and hence will require major alterations in the ground segment laid out for ATS-F. Moreover, the cancellation of plans for ATS-H and I remove any back-up for CTS. It should be kept in mind that current educational satellite experiments rely heavily upon ATS-1 and ATS-3 which are somewhat limited in life (being past their design lifetime), power and channel capacity.

The reason given by NASA for phasing out its communications satellite R and D program was that the private sector in the U.S. has reached a stage where it is fully capable of supporting necessary R and D in this area and there is no longer any need for NASA initiatives and support. There is in fact a generation of commercial domestic communications satellites about to come into being. However, in general, these are relatively low power satellites which serve expensive earth terminals. They are designed primarily to serve commercial markets and offer few incentives for educational use. Although it is conceivable that private interests may wish to stimulate educational usage, particularly interests related to cable television, most of the educational communications experiments and planning to date have been oriented towards the development of high-power satellites serving inexpensive earth terminals. This line of development appears to be in serious danger of being cut off.

Figure 6 illustrates possible educational satellite services in the U.S. and Table 6 summarizes primarily roles in education which satellites may provide. If and when operational educational services are implemented, they are likely to be developed in conjunction with local distribution facilities such as cable-television systems, Instructional Television Fixed

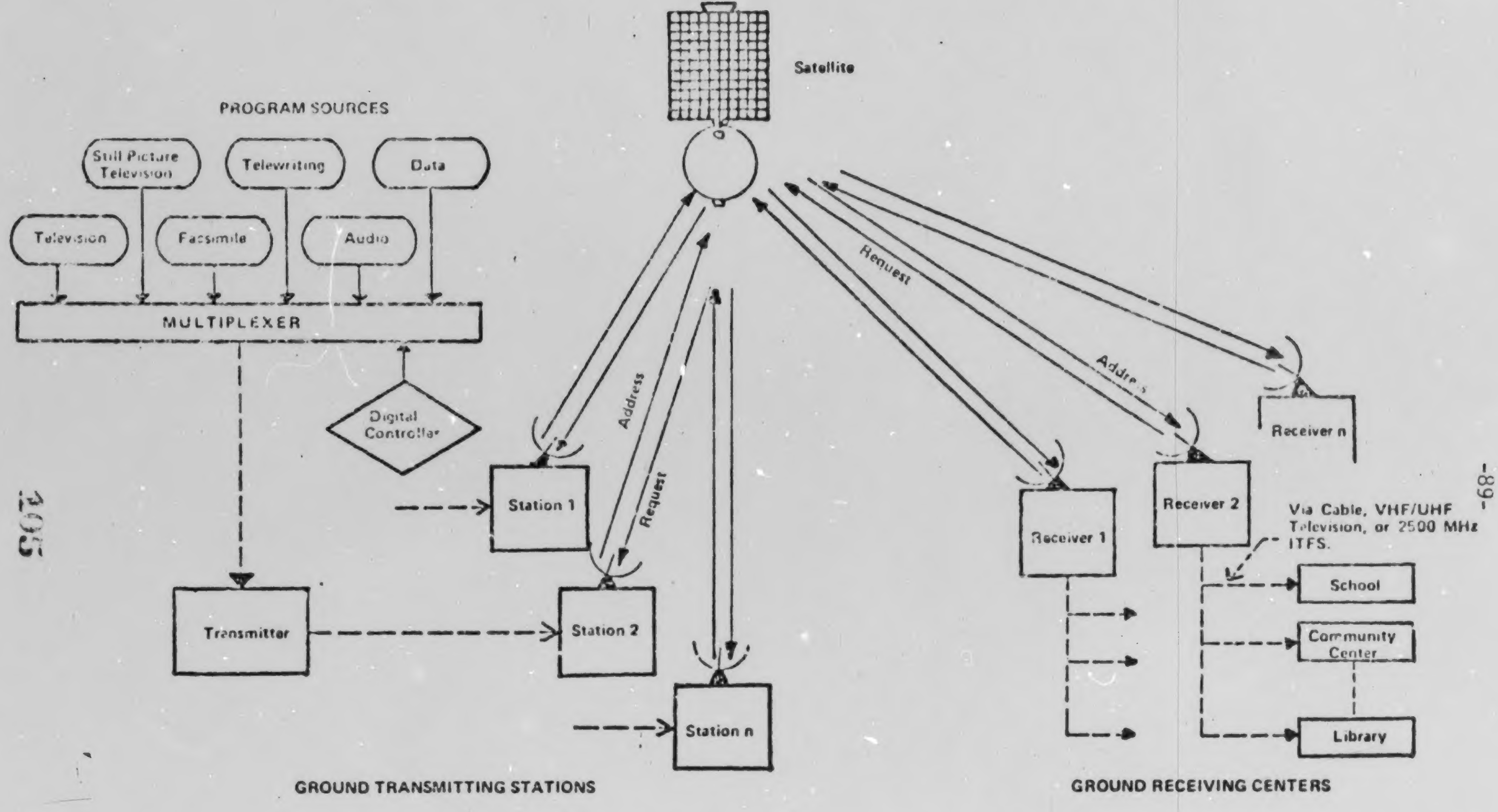
PROGRAM SOURCES
Still Picture Television
Telewriting
Data
Television
Facsimile
Audio
MULTIPLEXER
Digital Controller
Transmitter
Station 1
Station 2
Station n
Address
Request
Satellite
Request
Address
Receiver 1
Receiver 2
Receiver n
Via Cable, VHF/UHF Television, or 2500 MHz ITFS.
School
Community Center
Library
GROUND TRANSMITTING STATIONS
GROUND RECEIVING CENTERS

Figure 6 : EDUCATIONAL SATELLITE SERVICES*

*from Ref. 81

Table 6 : Primary Roles for Satellites Towards the Delivery of Certain Educational Communications Media and Services*

SERVICE	PRIMARY ROLES FOR SATELLITES
Instructional Television	Direct delivery to schools and learning centers, to broadcast stations, ITFS and cable headends for further redistribution.
Computer-Assisted Instruction	Delivery of CAI to small, remote institutions, particularly those 70-80 miles or more away from a major metropolitan area.
Computing Resources	
Multi-Access Interactive Computing	Delivery of interactive computing to remote institutions for the purposes of problem solving and implementation of regional EIS.
Remote Batch Processing	Delivery of raw computing power to small, remote institutions for instructional computing and administrative data processing.
Computer Interconnection	Interconnection of the computer facilities of institutions of higher education and regional computer networks for resource sharing.
Information Resource Sharing	
Interlibrary Communication	Interconnection of major libraries for bibliographic search and interlibrary loans, etc.
Automated Remote Information Retrieval	Interconnection of institutional and/or CATV headends with major information storage centers.
Teleconferencing	Interconnection of educational institutions for information exchange without physical movement of the participants and for gaining access to specialists.

*from Ref. 23

Service (ITFS) systems, regional terrestrial networks, and broadcast facilities. The use of satellites for direct delivery of services to roof-tops of schools and learning centers is of interest in areas where topographical and/or demographic conditions make local distribution and interconnection systems less attractive economically - areas such as Alaska, the Rocky Mountains and parts of Appalachia. Satellites look promising for delivery of educational services to wide but sparsely populated areas and for interconnection of cable systems, but the cable-television head-end interconnection is not necessarily promising unless educational interests can make greater inroads into local cable systems. Cable systems tied together by satellite could conceivably provide a second interconnection for public television programs.

5. Factors Working Towards More Widespread Technology Utilization

Some of the factors working towards more widespread technology utilization in higher education are similar to those in elementary and secondary education discussed previously. However, there are additional factors which are pertinent to higher education which make this sector a more attractive one for those interested in seeing more technology utilization. These factors include:

a) Support for technology utilization by organizations which might possibly influence the future course of events. Such support has been expressed by the Carnegie Commission,(60) The Newman Report,(61) and the Commission on Non-Traditional Study.(63) This support, coupled with growing interest in "the systems approach" and accountability makes for a more favorable climate for technology utilization in higher education than in elementary and secondary education. In the latter, there are fewer influential voices calling for increased technology utilization.

b) Development of state university TV networks and of regional computing networks. Large state universities are showing increased interest in reaching other parts of developing state systems of higher education using telecommunications.(19A) Regional computing networks hooking smaller institutions to larger ones are coming into being.(70) Libraries seek to economize by entering into cooperative resource sharing agreements. There appears to be both a pattern of utilization and a momentum developing which favors even greater utilization.

c) The thrust towards diversity and non-traditional forms. The report of the Commission on Non-Traditional Study(63) documents the movement in higher education towards new forms and delivery mechanisms which differ from past activity. External degrees, "open universities," "universities without walls," are phrases heard more and more these days. During this period of change and experimentation, opportunities for technology utilization are probably greater than in a sector which is remaining relatively stagnant, such as elementary and secondary education.

Demerath and Daniels,(19) in a study entitled "How to Make the Fourth Revolution:* Human Factors in the Adoption of Electronic Instructional Aids," state that:

> "New academic programs and new models of education hold the most promise for technology innovators. External degree programs hold special potential because they can apply to several kinds of students to the extent that the programs do three things:
>
> a) To the extent that they credit non-academic experience, they apply particularly to New Students and to mature adults. However, the credits and credentials will enjoy good repute only so far as they are based on standards as high as those of traditional degrees. That is, they should reflect a change in emphasis, not quality. Further, it seems important that the New Students perceive learning experiences as both feasible and pleasant before they attempt individualized study.

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* The phrase "The Fourth Revolution" is used by the Carnegie Commission to describe the impact of electronic media on education. (60)

b) To the extent that they permit transfers of credits between institutions, they will be valuable to mature adults whose jobs require mobility and to other students who seek a variety of experiences in education.

c) To the extent that they allow students to structure their own curricula and course content, they can serve highly motivated students who are discontented with the restrictions of traditional institutions.

It is likely that the rapid expansion of external degrees will promote the use of technology The flexibility it promises will be an important component of such programs. In fact, without such flexibility these programs can hardly be expected to succeed. External degree agencies may well be a key source of technological innovation. And as they send their students into traditional student bodies, these students may prove to be effective change agents, persuading their fellow students to appreciate the positive aspects and potential of technology. This in no way diminishes the importance of building innovative networks of persons, associations and institutions. The Fourth Revolution will not just happen."

d) Continued but limited growth in the higher education sector and corresponding rise in expenditures. Unlike elementary and secondary education, both enrollments and expenditures are expected to continue to increase throughout the 1970's, albeit at a much smaller rate than had previously been anticipated. Technological innovation may be more possible under growth conditions than under a more constrained situation.

e) Student Expectations. Many students entering college have already been exposed to a variety of experiences with communications media. On some campuses, they are a force working for changes which favor technological innovation.*

f) Current emphasis on technology utilization in higher education. Spurred on by the success of the Open University in Great Britain, there is now considerable emphasis on supporting somewhat similar activities and demonstrations at the post-secondary level in the United States. A small number of U.S. colleges and universities are currently experimenting with British Open University materials. Two large educational technology demonstrations involving the TICCIT and Plato CAI systems are being sponsored by the National Science Foundation directed heavily at the junior college level. Several large state universities have "external degree" or "open university" systems in varying stages of planning and implementation. The State University of Nebraska project supported by the National Institute of Education and its possible extension to the newly formed University of Mid-America are of particular interest.

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* It should be noted, however, that the technology of interest may not be of the large-scale, networking variety. (106)

6. Factors Working Against More Widespread Technology Utilization

Many of the resistance factors described previously in connection with the public schools are pertinent in higher education as well. However, there appears to be more diversity in higher education and possibilities for innovation seem greater.

Although economic pressures on private, "elite" universities would seem to work towards greater technology utilization, these universities tend to be tradition-bound and more geared towards smaller classes and extensive student-teacher contact.

Large state universities have used television to extend classroom instruction in basic courses to large numbers of students. However, such utilization may give rise to feelings of impersonalization.

Some community colleges are structured somewhat similar to public schools in terms of funding and operation. At this level, unionization may become extensive. In addition, in some large universities, professors are beginning to move towards collective bargaining, although the predominant mode of organizations still appears to be professional associations.

In many colleges and universities, professional advancement is heavily dependent upon performance and publication of scholarly research. A key factor limiting use of technology is the development of high quality software or courseware. Faculty members will resist getting involved in such software development unless there are adequate rewards and incentives for doing so.

A more extensive discussion of resistances to technology utilization in higher education can be found in Ref. 82.

7. Conclusions

There would appear to be considerable activity in higher education involving communications media and technology, particularly in large state universities and at the community college level. Extensive involvement with computers for research and administration is a reality, and regional computing networks are coming into being. The federal government has supported a number of large-scale projects (PLATO, TICCET, SUN, Regional Computing Networks, etc.) of a type which are necessary to answer key questions concerning further technology-based development. A number of surveys and forecasts predict extensive utilization of technology for instruction within the next ten to twenty years, particularly in more non-traditional forms of higher education.

Potentially promising applications in higher education for which a large-scale educational telecommunications system may find acceptance include:

a) Reaching wider populations of college students through televised and computer-aided instruction. There is increasing emphasis on "external degree" programs, i.e., programs in which students receive a significant proportion of their education off campus. The N.I.E. supported State University of Nebraska open learning project and its extension to a regional setting through the University of Mid-America will be an important step in the development of open learning systems using television. The outcome of N.S.F. supported demonstrations of PLATO and TICCIT CAI systems at the community college level are also of importance.

b) Continuing professional education*

A growing number of universities deliver instruction via television to individuals at industrial and other locations. The Surge Program in Colorado uses videotapes to provide graduate engineering courses to an extensive audience. Some 15-20 universities have developed similar programs using a variety of delivery mechanisms including videotapes, microwave, and ITFS. Wong found in a recent survey that the directors of these networks were optimistic about future growth and interested in participating in an expanded regional or national network arrangement.(19A) Whether such an arrangement would be cost-effective remains to be investigated.

c) Regional computing networks and information networks.

There are some thirty examples of regional computing networks in which a large central facility serves a number of outlying colleges. Specialized information networks for various disciplines (health, science, etc.) and for library sharing are being created. Depending upon support and acceptance, it is possible that these kinds of activities will grow in the future.

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*See also Section IIF.

Although higher education has been and will be involved in educational satellite experiments and demonstrations, the extent of future educational satellite development and utilization is not at all clear at this stage, particularly in view of NASA's decision to withdraw from communications satellite R and D in favor of private industry, and in view of the limited resources of other interested government agencies such as HEW and NIE.

Continued future development of high-power educational satellites seems likely to depend upon; (1) the extent to which government agency support for R and D can be obtained, (2) the success of satellite experiments and demonstrations now underway, and (3) the extent to which significant educational users (for example, the Public Broadcasting Service) find the satellite technology satisfies their needs. In early 1975, a Public Service Satellite Consortium was formed to bring together potential satellite users. In addition, the Public Broadcasting Service was exploring the possibility of satellite interconnection of 150 public broadcasting stations.

D. VOCATIONAL/TECHNICAL EDUCATION; CAREER EDUCATION*

1. Introduction

The traditional approach to occupational training has usually been referred to as "vocational and technical education," indicating formalized instruction to either prepare students to enter an occupation that requires less training than a bachelor's degree or to retrain them. Vocational/technical education normally occurs at three instructional levels: 1) the secondary, or high school, level, 2) the post-secondary, or post high school, level, and 3) the adult level, involving students beyond the compulsory school age of 16 and not enrolled in a formal educational program. Instruction, at any level, may occur in public or private educational institutions, at work, in residential schools, or in the military establishment. There is also interest in the prospects for vocational/technical instruction in the home.

"Career Education" is a recent development which was articulated at the beginning of the 1970's.** (See Figure 7.) In a 1972 paper, Robert M. Worthington, Associate Commissioner for Adult, Vocational and Technical Education of the U.S. Office of Education, characterized career education as follows:

> "Career Education is a revolutionary approach to American education based on the idea that all educational experiences, curriculum, instruction, and counseling should be geared to preparing each individual for a life of economic independence, personal fulfillment, and an appreciation for the dignity of work. Its main purpose is to prepare all students for successful and rewarding lives by improving their basis for occupational choice, by facilitating their acquisitions of occupational

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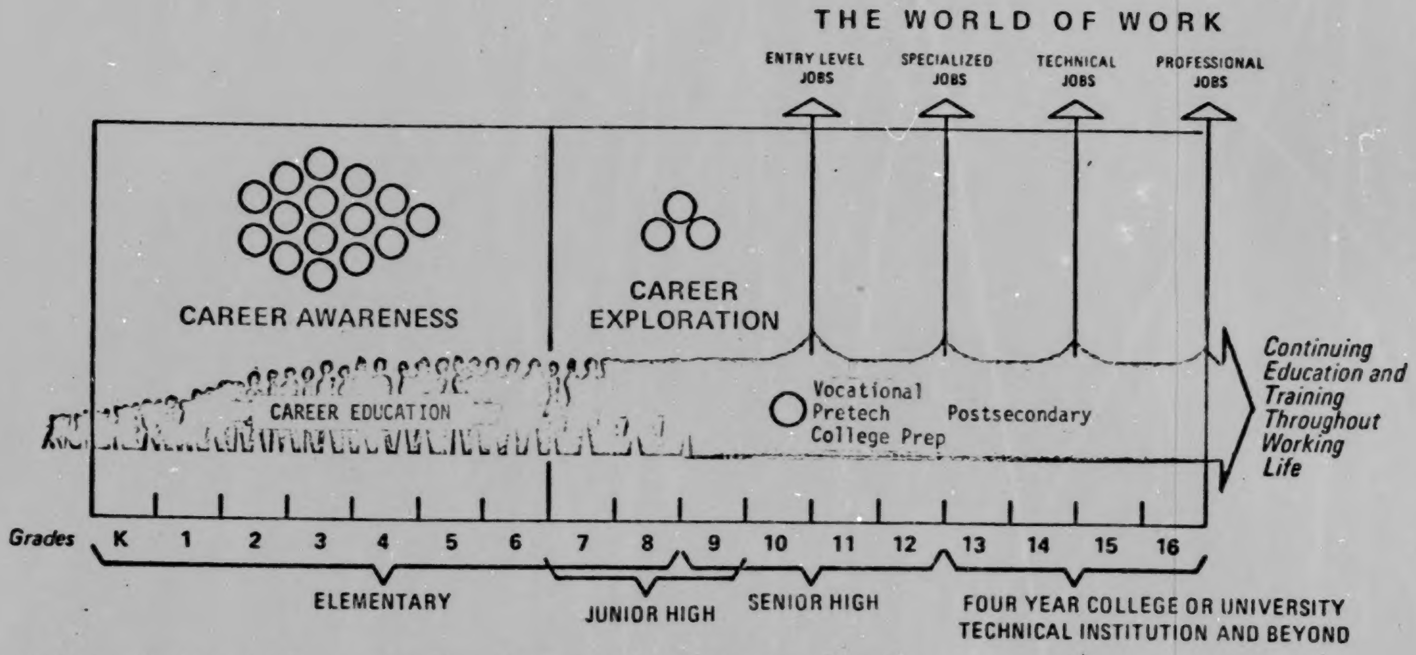
*This section is based in part upon a study by Rothenberg, dated January, 1973. Additional supporting references may be found in the study report. (14)

**For a detailed account of the emergence of career education and its relationship to vocational/technical education, see Bailey and Stadt. (108)

FIGURE 7

A MODEL OF CAREER EDUCATION


THE WORLD OF WORK
ENTRY LEVEL JOBS
SPECIALIZED JOBS
TECHNICAL JOBS
PROFESSIONAL JOBS
CAREER AWARENESS
CAREER EXPLORATION
CAREER EDUCATION
Vocational
Pretech
College Prep
Postsecondary
Continuing Education and Training Throughout Working Life
Grades
K
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
ELEMENTARY
JUNIOR HIGH
SENIOR HIGH
FOUR YEAR COLLEGE OR UNIVERSITY
TECHNICAL INSTITUTION AND BEYOND

Source: United States, Department of Health, Education, and Welfare, Office of Education, Career Education (Washington, D.C.: Government Printing Office: 1971), p. 5.

skills, by enhancing their educational achievements, by making education more meaningful and relevant to their aspirations, and by increasing the real choices they have among the many different occupations and training avenues open to them. While it is anticipated that Career Education would increase the opportunities available to the disadvantaged, it is not explicitly designed to involve any particular group or segment of society. It is directed at changing the whole educational system to benefit the entire population.

Career education recognizes the critical decision points when students must be prepared and equipped to decide whether to pursue a job or further education or some combination of both work and formal study. It is a lifelong systematic way of acquainting students with the world of work in their elementary and junior high school years and preparing them in high school and in college to enter into and advance in a career field of their own choosing. For adults it is a way to re-enter formal as well as informal programs of education at any time to upgrade their skills in their established career field or to enter a new career field. It is similar to vocational education, but there is a fundamental distinction. For while vocational education is targeted at producing specific job skills at the high school level and up to but not including the baccalaureate level, Career Education embraces all occupations and professions and can include individuals of all ages whether in or out of school. (109)

2. Statistics and Growth Trends

In 1970, according to HEW statistics, there were 8,793,960 students enrolled in vocational/technical education programs at all instructional levels.* The majority of the students, 5,114,451, were enrolled at the secondary level. 2,666,083 students were involved at the adult level. Included within the total vocational/technical enrollment were the 920,603 students of "special needs;" 805,384 of whom are classified as "handicapped." These enrollment figures, compiled by the federal government from data supplied by the states, do not reflect the numbers of students in proprietary vocational schools. Estimates of proprietary school enrollment range from 35,000 such schools serving a student population of more than

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*Difficulties encountered in compiling statistics for vocational/technical education have been discussed by Rothenberg. (14)

5 million advanced by Clark and Sloan in 1964, to Belitsky's 1966 survey which estimated 7,000 institutions serving one and one half million students.(110) Enrollment in proprietary correspondence schools would increase these figures.

Growth potential for vocational/technical education is considered good. A June, 1971 publication of the Bureau of Adult, Vocational and Technical Education projects vocational/technical education enrollments at public institutions for 1975 to equal 13,800,000 students, of whom 8,247,000 will be enrolled at the secondary level; 1,830,000 will be enrolled at the post-secondary level; 3,723,000 will be enrolled at the adult level; included in these estimates are students with "special needs" (the handicapped and the disadvantaged) who will equal 1,412,000 enrollees. The outlook for private vocational schools also indicates growth. The Education Amendments of 1972 (P.L. 92-318) passed by Congress in June, 1972, direct the states to establish/designate a state agency to coordinate all institutions of higher education (including proprietary vocational schools) within their boundaries as a means of implementing the maximum optimization of educational opportunities for their citizens. Vocational/technical education is a primary concern of the 1972 legislation.

Vocational/technical education has shown a marked increase in federal support over the last decade. In 1962 less than $100,000,000 in federal obligations for vocational/technical and continuing education were incurred. The actual 1972 federal outlay in these categories was $2,505,095,000, some 15.2% of all federal funds for education and related activities.(87) Of the total of over 2.5 billion dollars, 77.5% ($1,941,281,000) was for "Vocational, Technical and Work Training" and 17.1% ($429,229,000) was for "Veteran's Education." This rapid increase in federal spending on vocational/technical education may not continue. Estimated federal expenditures for 1973 and 1974 are slightly less than the 1972 outlay for the "Vocational, Technical and Work Training" category.(87)

3. Uses of Technology and Telecommunications

Current uses of technology and telecommunications in vocational/technical and career education center around several applications. These include use of various media as instructional aids in occupationally specific curricula; use of computers in vocational counseling and career guidance systems; and dissemination of career education materials via telecommunications. These uses will now be briefly described.

a) Media Use for Occupationally-Specific Curricula

The Southern California Regional Occupational Center, a consortium of seven school districts serving 25 high schools, has utilized computer management of self-contained, multi-media instructional packages to teach a wide range of occupational specialties.(111) The Northwest Regional Laboratory in Portland, Oregon has developed Project REACT which uses CAI to teach electronics and welding to rural students in parts of Idaho and Washington.(112) Rural students worked from terminals within their schools which were connected via telephone lines to a central computer in Seattle. The United States military trains men for specific occupations with heavy audio-visual input. Applicability of military courses to civilian classrooms has been tried by Hill Air Force Base and the state of Utah. Military materials, heavily audio-visual in nature, were found suitable to civilian instruction.(113) Industrial firms like IBM make use of various technologies for teaching specific skills. Such use does not, however, appear to be widespread in public and private vocational education.

b) Computerized Vocational Guidance and Career Information Systems

Two examples of computerized vocational guidance and career information systems are CVIS and SIGI. Both these systems use computer-assisted instruction to aid students in deciding among career options and upgrade the quality of vocational counseling by providing assistance to the counselor. Several other projects are described elsewhere.(113A)

The Computerized Vocational Information System (CVIS) is a cooperative project of Willbrook High School and the College of DuPage, funded by the State of Illinois Board of Vocational Education and Rehabilitation, Division of Vocational and Technical Education. Operating at the junior high, senior high, and community college levels in a suburban community west of Chicago, CVIS has been developed as a means of orienting students at each instructional level to the variety of career options available to them that are in line with the individual's background and preferences as shown by type and quality of school work, extra-curricular activities, test scores, and selections and responses to computerized scripts and related questions. By using the branching technique, CVIS aims for individualization of information, either isolating difficult counseling cases or providing students with relevant information at a decision-making juncture.

As of June, 1971, CVIS was operational at the secondary and community college levels, and was being expanded for the junior high level. At the secondary level, career options included continued academic study (including post-secondary technical schools), entry-level jobs available locally, military service, apprenticeships, and occupations. Hardware is IBM, programming is in basic assembly language, with the computer center at the

College of DuPage County in Glen Ellyn, Illinois, serving Project CVIS, the College of DuPage, and the DuPage County Data Processing Cooperative. Service to the remote terminals in the system is via telephone lines.(114)

The System of Interactive Guidance and Information (SIGI) was being developed by the Educational Testing Service to aid the counseling crunch at the community college level, under funding by the Carnegie Corporation and the National Science Foundation. SIGI is designed to aid the community college student in planning his course of studies by helping him to determine his ultimate career goal. In a series of computer-student interactions based upon the student's occupational values as related to pertinent information regarding job information, curriculum planning, and likely success, the system endeavors to equip the student with a viable career plan and decision-making skills.

SIGI was reported to have been completed by the summer of 1972, and is being demonstrated at Mercer County Community College, New Jersey. The system has been designed so that it will have wide applicability at a number of institutions. Possible hardware configurations include on-site capability or remote capability. On-site capability allows for eight local terminals utilizing a Digital Equipment Corporation PDP-11 minicomputer. Remote capability allows for twenty or more remote site terminals serviced by the same computer equipped with additional core memory and discs connected by telephone lines.

Cost is figured by adding operational expenses and indirect costs based on a usage rate of 1,200 hours annually, or 200 days annually at 6 hours per day. Comparatively, at the same usage rate, a counselor salaried at $15,000 per year would cost approximately $12.50 per hour. A SIGI installation is expected to cost \$3 to \$5 per hour, prorated accordingly; a 6-station set-up would cost between \$2 to \$4 per hour with the possibility of an additional \$1 per hour in indirect costs, such as power, space, etc. Cost forecasts are based upon outright purchase of the equipment, 5-year uniform depreciation, and maintenance contracts for parts and labor on all equipment.(115)

c) Career Education Via Satellite

Career education is a major element in the Health Education Telecommunications Experiment using the ATS-6 Satellite (see Section IIC5). This partially reflects the current emphasis on career education emanating from the federal government. It also reflects the development of career education as a concept which lends itself to curriculum development broad enough for distribution over broad areas to large audiences. The Federation of Rocky Mountain States will disseminate a wide variety of career education materials, including television programs to junior high schools in an eight state region. The University of Kentucky will use the satellite to deliver in-service education courses and supporting information services in career education to teachers in the Appalachian region.(143)

4. Conclusions Regarding Telecommunications in Vocational/Technical and Career Education

The extent to which large-scale telecommunications will be used in vocational/technical and career education in the future will depend upon a number of factors. Among those tending to favor increasing use have been the large increase in federal funding for vocational/technical education over the past decade and the emergence of career education as a new concept which is less occupationally specific than vocational/technical education. Career education is beginning to emerge as a curricular area broad enough for wide dissemination to distant audiences. These factors have combined to give career education a prominent place in the Health Education Telecommunications Experiment using the ATS-6 Satellite, both for student instruction and teacher training. Computerized vocational guidance and career information systems such as CVIS and SIGI fit well within the career education and large-scale telecommunications constructs.

On the other hand, it should be kept in mind that career education is a very recent phenomenon. Although supported by a variety of organizations,* new concepts may not always fulfill the wishes of their designers. Furthermore, the extent to which specific curricular materials emerge which will be of long-term and widespread interest to schools, or a part of a telecommunications based delivery system, remains to be demonstrated. Computerized vocational guidance systems are only as good as the information put into them (matching training to demand has been a problem that has long plagued vocational education) and a growing concern about privacy may require reexamination of their practices.

It should be pointed out that conceptual work on delivery systems is not solely focussed on schools as locations of students. In FY 1971 and 1972, the USOE began development of four conceptual models for career education; 1) School-based model; 2) Employer-based model; 3) Home/community-based model; and 4) Rural/residential based model. Thus learners in career education may turn out to be at non-traditional learning sites such as industrial locations, homes and community centers as well as schools. Pilot studies of all these models are being carried out but at a modest level of funding ($15,000,000 in FY 1972).(14)

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*"The Manpower Council, the Panel of Consultants, the Advisory Council, the National Advisory Council on Vocational Education, and educational leaders have come rather naturally to the realization that career development must be the core, the major thread, of education in a society which is so well advanced technologically that it endangers the human condition." (108)

Prior to the emergence of career education, and still to a large extent reflecting the actual state of affairs, vocational/technical education represents an activity that takes place in a variety of institutions, both public and private, and at a variety of levels. It can be "purchased" by students either for "free" in tax-supported schools or at high cost in proprietary vocational schools.

The rapid increase in vocational/technical educational spending in the 1960's and the growing federal support base has brought with it an infrastructure which may ease the way towards a large-scale telecommunications system. Considerable new activity has been fostered within the states by the Vocational Education Act of 1963, the Vocational Amendments of 1968 and the Educational Amendments of 1972. The latter legislation aimed in part to bring about better coordination and planning of the postsecondary level in vocational education. Regional educational laboratories and specialized information centers focussing on vocational/technical education have come into being. The basis for a nationwide "language" for the field of vocational education has been provided with the Department of Labor's Dictionary of Occupational Titles, which codifies individual occupations. In addition, proprietary vocational schools have undergone concentration, with large companies having media experience (e.g., G.E., Philco-Ford, ITT, Westinghouse Learning) acquiring ownership.

However, taken as a whole, vocational/technical education in the sense of education for specific occupations seems to hold much less promise than career education for large-scale electronic delivery. Although computerized vocational guidance programs and job banks may prove to be useful, the large number of specific occupations comprising vocational education and the fragmented nature of the field seem to make it less attractive for other kinds of resource sharing. If technology does find use in vocational/technical education, it seems more likely that video cassettes and film strips will find a niche rather than large-scale networks.

E. ADULT EDUCATION

1. Introduction

Adult education is a difficult field to define precisely. Statistics concerning adult education enrollments vary and there is overlap with other areas such as vocational education and non-credit enrollments in higher education. But in general, adult education refers to educational experiences designed for individuals of some minimum age who are not enrolled in school on a full-time basis. The term "adult education" can span a broad range of compensatory and continuing education activities, both formal and informal.(116)

a) Adult Basic Education

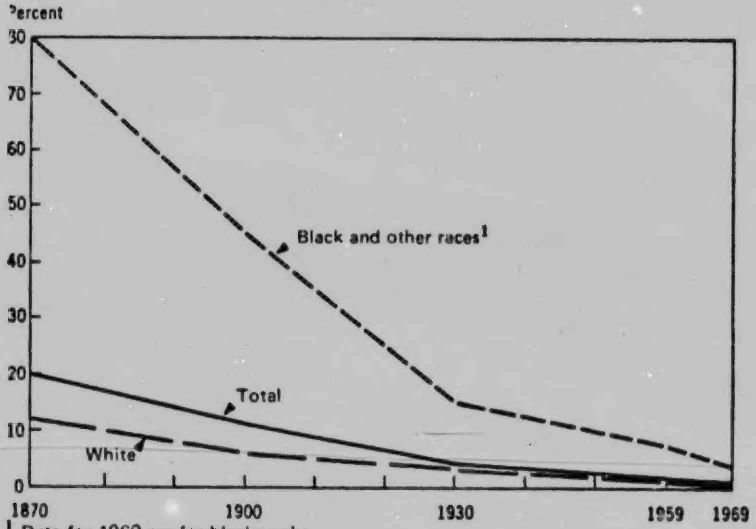
"Adult basic education" has been the subject of national interest and legislation since 1964 with efforts to train adult illiterates under Title II-B of the Economic Opportunity Act of 1964 (p.L. 88-452).(117) The focus of this legislation was upon assisting adults whose lack of skills in reading and writing restricted their employment possibilities. Subsequent legislation in the 1960's retained this emphasis.(117) The Office of Education's "Right to Read" program is one of the more recent of these efforts.(118)

Griffith pointed out in 1970 that there is no universally acceptable definition of key concepts such as illiterate, functionally illiterate, and basic education. Views vary on whether a basic education includes an eighth grade or a twelfth grade (high school) education. Previous legislation seemed to use the eighth grade as a demarcation level, but the overall movement towards more formal education in the U.S. tends to reinforce the needs for higher levels of education for individuals to function effectively.(117)

In spite of definitional difficulties, some idea of the magnitude of the need may be gleaned from various reports. According to a 1968 report, in 1960 there were about 24 million persons 18 years of age or older who had not completed eight years of formal schooling. Griffith points out, however, that this is likely to underestimate the magnitude of the problem.(117) Other surveys show that about 1.5 million adults cannot sign their own names. More than 17 million cannot perform simple tasks like filling out a job application form or understanding a driver's license exam.(118) Although some progress seems to have been made in the 1960's in cutting the illiteracy rate in half, November 1969 census data indicates that 1.0% of the population 14 years of age and over were unable to read or write a simple message in English or some other language.(187) A survey by Louis Harris and Associates conservatively estimated that 18 million persons 16 years of age and over lacked necessary functional literary skills for survival!(123) A recent study found that one million youths aged 12-17 years old, representing 4.8 percent of that age group, cannot read at even the fourth grade level and suggests further that illiteracy is more pervasive than ever before realized.(120) In this latter study, illiteracy was found to be most prevalent among males, especially Blacks from low-income families where parents had little or no formal education. Illiteracy rates in 1969 were also higher for Blacks than for the overall population (see Figure 8.) although tremendous strides have been made in reducing illiteracy among the Black population. Figure 8 is a graphic indication of decades of injustice in the U.S., stemming from an era when it was illegal for Blacks to receive an education in this country.

Table 7 presents percentage of high school dropouts among persons 14 to 24 years old by race and sex in the United States for the years 1967 and

Figure 8—Percent of illiteracy in the population, by race: United States, 1870 to 1969



[1] Data for 1969 are for blacks only.

NOTE.–Data for 1870 to 1930 are for the population 10 years old and over; data for 1959 and 1969 are for the population 14 years old and over.

SOURCE: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P–20, No. 217 (From Ref. (87))

TABLE 7.—Percent of high school dropouts among persons 14 to 24 years old, by race and sex: United States, 1967 and 1972

Age	1967				1972			
	Negro		White		Negro		White	
	Male	Female	Male	Female	Male	Female	Male	Female
1	2	3	4	5	6	7	8	9
Total, 14 to 24 years old	23.9	21.8	11.6	13.1	17.8	17.2	10.7	11.9
14 and 15 years old	3.5	4.0	1.5	1.4	2.4	2.7	2.3	2.5
16 and 17 years old	11.7	14.6	7.0	9.4	9.4	7.6	7.8	9.6
18 and 19 years old	30.6	22.0	15.4	16.3	27.1	21.0	13.5	13.2
20 to 24 years old	42.6	36.1	18.8	19.0	27.2	27.3	15.3	16.6

NOTE.—Dropouts are persons who are not enrolled in school and who are not high school graduates.

SOURCE: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-23, No. 46. (From Ref. (87))

1972. Dropouts are defined as persons who are not enrolled in school and who are not high school graduates.(87)

b) Adult Education: Adult Continuing Education

The bulk of organized activity for adults other than full-time enrollment in educational institutions or adult basic education might be designated as adult continuing education or just plain adult education. Included might be activities such as courses in accident prevention, auto mechanics, bridge, cooking, electronics, foreign languages, personnel management, race relations, real estate, speed reading, and swimming.(119) In a survey of participation in adult education to be discussed shortly, adult education was essentially defined by the participants' responses to questions. Among the questions asked were, have you: 1) taken any adult education classes in a public or private school, 2) attended a college or university part-time, 3) taken any job training classes, 4) taken a correspondence course, 5) taken any classes or educational activities in a neighborhood center, church, or other community organization, 6) taken any private instruction such as music lessons or language tutoring, 7) any other educational activities or courses during the past 12 months.(119) A more detailed supplemental questionnaire followed.

Thus the adult education field covers a broad range of activities. Statistics to be reported in the next section exclude full-time students under 35 years of age. They include survey respondents 17 years and older and thus will overlap with non-credit and part-time for-credit higher education statistics. They might or might not include informal public television viewing, although TV or radio was one category asked for under the question: How was this course or activity conducted. They would probably include responses from those taking graduate continuing professional education courses. The phrase "continuing education" seems to have the connotation that the activity is associated with some educational institution (such as a university's continuing education program) whereas adult education appears to be more all encompassing.

2. Statistics

Tables 8 and 9 present statistics on participants in adult education for 1969 and 1972 by source of instruction and by type of program. Figure 9 gives the age distribution. In 1972, survey results indicate that there were 15,734,000 individuals* participating in adult education, a 20.7% gain since 1969.** From these tables it can be seen that there is a variety of sources of instruction, ranging from colleges to on-the-job courses, to community organizations to individual tutors. Types of programs include general education, occupational training, community issues, personal and family living, social and recreational lessons.

A report on Non-credit Activities in Institutions of Higher Education in 1967-1968 gives some information about media use in those institutions.(121) Television and/or radio was indicated as the primary teaching medium by 6.5% of respondents in the public sector and 3% in the private sector. When electronic media were utilized in noncredit instruction, regardless of how the institution was controlled, broadcast television was most popular in 2-year institutions, followed by universities, and least used by "other" 4-year institutions. Broadcast radio was most used by "other" 4-year

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*A National Opinion Research Center estimate, cited in a 1971 report, indicated some 24,810,000 adults in some kind of continuing education.(124)

**See previous section for discussion of what statistics include.

TABLE 8.—Participants in adult education, by source of instruction: United States, 1969 and 1972

Source of instruction	Participants (in thousands)		Percent Change, 1969 to 1972
	1969	1972	
1	2	3	4
TOTAL	13,041	15,734	20.7
4-year colleges and universities . .	2,831	3,367	18.9
Employers	2,274	2,613	14.9
2-year colleges and technical institutes[1] . . . . in	1,550	2,561	65.2
Public elementary and secondary schools	1,970	2,200	11.7
Community organizations	1,554	1,996	28.4
Private trade, vocational, and business schools[1]	1,504	1,393	-7.4
Other (labor unions, professional associations, hospitals, tutors) .	2,552	3,360	31.7
Not reported	54	98	81.4

[1] Data for 1969 are for public schools only. Adjustment for private schools in 1972 could result in a change in 2-year colleges of 57.7 percent and in private trade, vocational, and business schools of +0.3 percent.

NOTE.—Detail does not add to totals because some participants received instruction from more than one source.

SOURCES: U.S. Department of Health, Education, and Welfare, Office of Education, Adult Education Participants and Participation, 1969. Full Report, and Adult Education Participants and Participation, 1972, Full Report (From Ref. (87)).

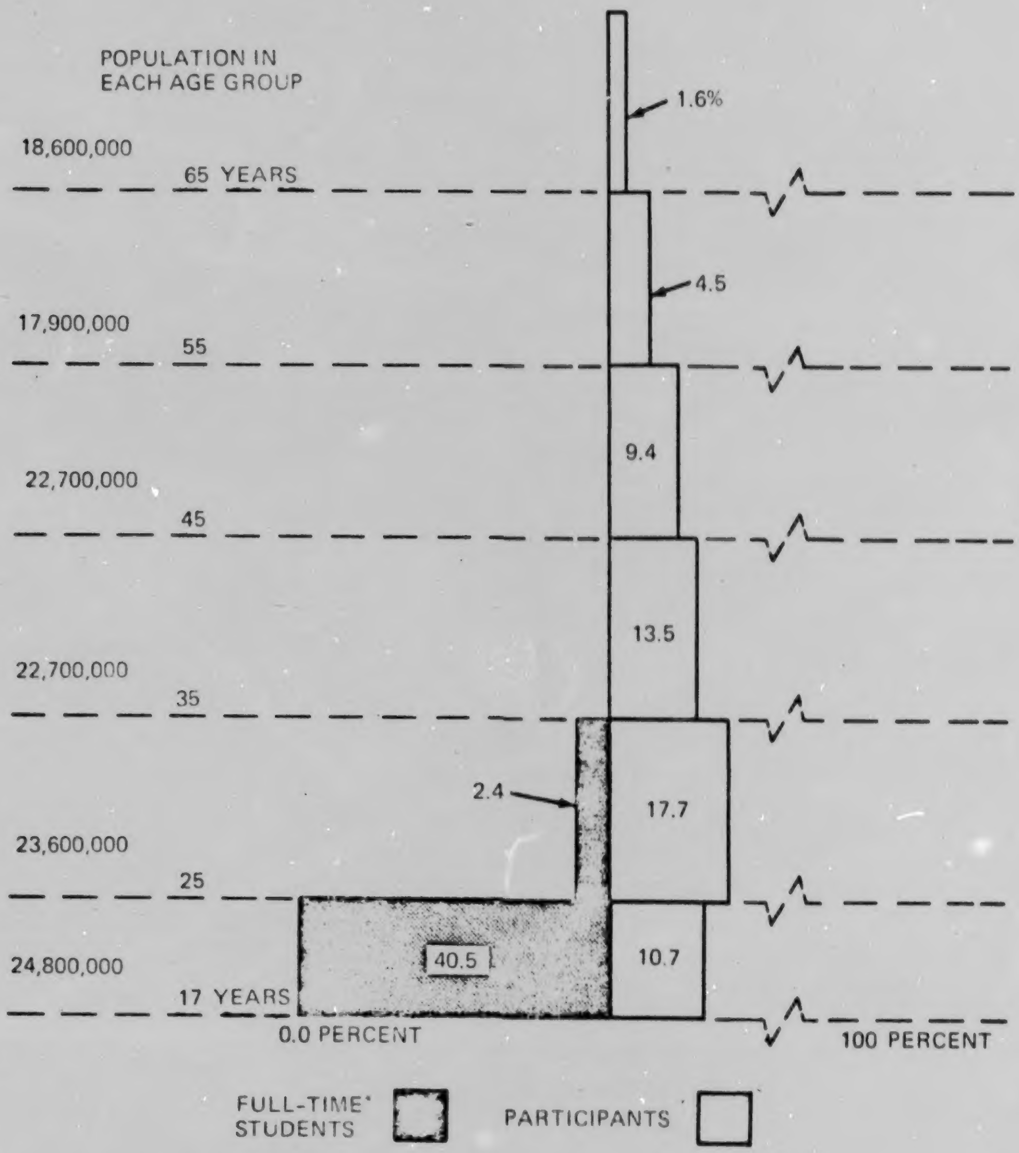
TABLE 9.—Participants in adult education, by type of program: United States, 1969 and 1972

Type of program	Participants (in thousands)		Percent change, 1969 to 1972
	1969	1972	
1	2	3	4
TOTAL	13,041	15,734	20.7
General Education	3,553	4,074	14.7
Occupational training	5,816	7,310	25.7
Community Issues	1,202	1,545	28.5
Personal & family living	1,580	2,209	39.8
Social & recreational lessons	1,552	1,895	22.1
Other & not reported	572	534	-6.6

NOTE.—Detail does not add to totals because some participants enrolled in more than one type of program.

SOURCES: U.S. Department of Health, Education, and Welfare, Office of Education, Adult Education Participants and Participation, 1969, Full Report, and Adult Education Participants and Participation, 1972, Full Report (From Ref. (87)).

FIG. 9—ADULTS AS FULL-TIME STUDENTS OR PARTICIPANTS IN ADULT EDUCATION, AS PERCENT OF TOTAL POPULATION, BY AGE GROUP: UNITED STATES, MAY 1969



SOURCE: Reference (119)

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*Persons age 35 and over were not asked if they were full-time students.

institutions, then by universities, and least used by 2-year institutions. Closed-circuit television was used minimally by all institutions, and closed-circuit radio was the least used of the instructional media. Broadcast television far outstrips use of closed-circuit television in adult/continuing education teaching situations.(14)

Table 10 gives FY 1972 data on participation in adult basic education programs. During that year, a total of 820,514 persons were involved, with heavy participation by minority groups.

An analysis of previous FY 1970 data by Rothenberg on adult basic education indicates the following:(14) Included within the FY 1970 adult basic education enrollment were 61,226 institutionalized students; increased enrollments in hospitals (9,571 students) and correctional facilities (32,536 students) were recorded. Geographically, adult basic enrollment was heaviest in California, Florida, Illinois, North Carolina, and Texas, which registered 34% of the national total. Adult basic education classes are offered in a variety of locations: correctional facilities, hospitals, community structures such as churches, community centers, and schools, and on-the-job locations such as plants. Programmed instruction is used in adult basic education. Statistics do not indicate if programmed instruction was achieved with electronic means, although it is likely that primarily printed materials are used. However, sixteen states reported that 50% of their adult basic education classes were receiving programmed instruction.(14)

It might be noted that the number of people involved in adult basic education is a relatively small fraction of participation in the overall field of adult education. During a five-year period from FY 1968 to FY 1972, a total of approximately $260 million in federal, state, and local

TABLE 10.—Participants in adult basic education programs, by race or ethnic group and sex: United States and outlying areas, fiscal year 1972

Age and Sex	Total	Race or ethnic group						
					Spanish-surnamed			
		American Indian	Negro/ black	Oriental	Puerto Rican	Mexican-American	Other	Others[1]
1	2	3	4	5	6	7	8	9
TOTAL	820,514	9,111	244,668	27,065	43,868	56,176	115,826	323,800
Unclassified[2] . . .	5,888	951	60	153	11	343	45	4,325
Classified	814,626	8,160	244,608	26,912	43,857	55,833	115,781	319,475
Men, total . . .	359,319	3,511	97,561	7,908	21,230	25,649	53,755	149,705
Women, total . .	455,307	4,649	147,047	19,004	22,627	30,184	62,026	169,770

SOURCE: U.S. Department of Health, Education, and Welfare, Office of Education, Adult Basic Education Program Statistics, fiscal year 1972. (From Ref. (87))

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[1] Not classified elsewhere in this table.

[2] Age and sex not reported.

funds was allocated to the Adult Basic Education program of the U.S. Office of Education,* Federal contributions grew from $29 million in 1968 to an estimated $50 million in 1972. Enrollments rose from 455,730 in 1968 to 820,514 in 1972. About 53% of participants attended classes in school buildings during FY 1972. There were far more evening than day classes. The 1972 student-teacher ratio was 31.6, showing continued increase, but the students per class fell from 20.0 per class (1971) to 13.8 students per class (1972), indicating that teachers were teaching more classes with fewer enrollees.(122)

Of 36,240 adult basic education personnel, only 25,950 were reported to have received training in 1972, and of those reporting training, 72% received 16 hours or less. Of the over 800,000 participants in FY 1972, 261,128 were employed, 159,018 were unemployed and 83,110 were receiving public assistance. Over 300,000 did not report economic data. 260,519 participants reported having upgraded their educational level by receiving an eighth-grade diploma, entering high school, passing the General Education Development test, graduation from high school, or enrolling in other education as a result of being in an ABE program. ABE tends to be more urban than rural by almost 4 to 1 although statistics are not complete.

3. Use of Technology and Telecommunications

a) Introduction

In this section, a general overview will be given of the use of technology and telecommunications in adult education. Emphasis will be placed upon three projects involving use of open-circuit television, in conjunction with other media, in bringing education of a compensatory nature to out of school adults. One of these projects, Project Strive of the proposed Adult Learning Program Service of the Corporation for Public Broadcasting, was never implemented. All three projects have four elements in common: 1) all are multimedia adult education packages (using accompanying printed materials, radio, etc.); 2) all use a human component (e.g., one program uses a paraprofessional home visitor), 3) all make some use of existing structure within individual, local communities for adult education, and 4) all structure the learning package, particularly the ITV component, to allow for flexibility in viewing habits, without penalty in skill acquisition.(14)

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*This program was established under the Adult Education Act of 1966. It "offers to persons 16 years of age and older the opportunity to overcome English-language difficulties and attain reading, writing, and computational skills through the 12th grade level of competence." On June 30, 1969, as a result of the Vocational Education Amendment of 1968, the 16 year old minimum age limitation superceded a previous 18 year old limit.(122)

b) "RFD"

"RFD" refers to "Rural Family Development," a coordinated, multi-media approach to adult education for rural adults. Funded by the Office of Education, "RFD" was produced by the University of Wisconsin Extension Division at studios in Madison, and aired over WHA-TV to the surrounding four-county area from January through May, 1971. The intent of the program was to reach the target audience with a lively half-hour weekly television program, weekly 3 1/2 minute radio spots, a monthly publication, access to a toll-free Action Line, visits by paraprofessionals, and specially-created learning materials for basic academic skills as requested by the viewer. The instructional goal was to impart living skills and basic academic skills, both in a low-key manner. The programs were not designed to be sequential, so that a viewer could miss a program or two. "RFD" hoped to reach its target audience, put it at ease about coping with shortcomings it may have, help remedy them, and inspire the individual viewer to initiate study of basic academic skills (reading, computation).(125)

Testing devices were created especially for the project. The University of Wisconsin Psychometrics Laboratory developed the Wisconsin Test of Adult Basic Education (to measure basic educational and coping skill achievement), the Wisconsin Adult Attitude Inventory (to determine the subject's alienation, if any, and attitude towards education), and The World About Me (to gauge the actual behavior of the subject).(126) Results indicated that the addition of the home visitor to the program had a somewhat limited effect on the viewer's acquisition of coping skills.(14)

A more general audience polling was made by sending questionnaires to 2,950 people who requested "RFD" materials by phone, mail, or personal appearance. Based upon a 31% rate of return, it was found that only 18% of the respondents had not had some form of post-secondary education. Since this 18% constituted the target audience, its responses were analyzed in comparison to those from the rest of the viewing public. Responses indicated that the undereducated viewer participated more than the educated viewer, enjoyed the programs and materials more, and learned more. The educated viewer, however, was better able to apply knowledge gained from "RFD" than was the target audience. As revealed by questionnaire responses, "RFD" found that it attracted a largely older viewer from its target audience; 54% of target audience viewers were over 55. A viewing survey indicated that viewership was about evenly divided between urban and rural homes, but that the programs still attracted an older audience.(126)

The cost component of the "RFD" experiment totaled $8,323.00 per week. Excluding television production, the highest-cost elements were for administrative salaries (including the Action Line supervisor and the home visitor supervisor). The cost of the home visit component was the fourth most expensive item, trailed only by Action Line and Radio spots. The cost per viewer per week may be estimated at $2.61 without the home visit, and $2.82 with the home visit.(14)

The initial "RFD" program was defunct as of 1972. However follow-on projects have included the Office of Education-funded "360 Project," which tested a multi-media system in 13 states and a new "American Pie Forum" program which is scheduled to begin state-wide operation in Wisconsin in October, 1974. American Pie Forum involves a multi-media delivery system applied to career education, funded by revenue sharing funds. The target audience is unemployed or underemployed adults. The program is viewed as being suitable for national distribution, subsequent to successful state-wide operation and market analysis.(127)

c) The G.E.D. Project of the Kentucky Authority for Educational Television (K.E.T.)

Currently in development is a multi media approach to preparing students for the high school equivalency examination (General Educational Development - G.E.D.). The G.E.D. is a national examination, available at recognized testing centers, to test the individual's capabilities in social studies, mathematics, English composition, natural sciences, and literature. Successful completion of all five parts of the test entitles the individual to a high school credential which is applicable in the same ways as a high school diploma earned by conventional means (i.e., college or military admission, licensing requirements). Since the G.E.D. is designed for an out-of-school population, testing emphasis is on intellectual facility rather than detailed content. Individual state departments of education establish passing scores to be recognized within that state, and individual colleges determine scores necessary for admission to that institution.(14) It is reported that more than 500,000 people take the G.E.D. tests annually with over half passing them and receiving high school certificates.(128) Individuals achieving high school graduation credentials in this manner constitute 12% of all yearly high school graduates.(128)

The Kentucky Authority for Educational Television (KET) is currently engaged in development of a project to prepare viewers for the G.E.D. Funding is from the Appalachian Regional Commission and the Kentucky State Government. K.E.T. identifies its potential audience as the 1,422,509 adult Kentuckians lacking a high school diploma, and the 6.5 million Appalachians without a high school credential. Of the eligible Kentucky population, only 6,630 took the G.E.D. during 1971. Working with the K.E.T. are representatives from the Kentucky State Bureaus of Vocational Education and Instruction, adult education teachers (for the G.E.D.) from the Appalachian counties of the state, and the Corporation for Public Broadcasting. Attention is being devoted to developing the best ITV strategies for the material, identifying and locating the target audience, developing effective liaisons with other agencies involved in adult education, and "development of other utilization components."(14)

The Kentucky G.E.D. series was scheduled to commence statewide on September 23, 1974. Thirty-three one-half hour instructional programs have been developed and will be shown on VTR's in learning centers. An additional program will involve orientation and test-taking. The programs will be released for national distribution in January, 1975.(128A)

d) Project Strive of ALPS

Project Strive was the title of what was to be the first adult education project of the Adult Learning Program Service (ALPS) of the Corporation for Public Broadcasting. Strive's goal was to reach its target audience (those without a high school diploma but with some secondary education) with skills to increase their confidence and increase their interest in continuing their education. Strive did not aim for G.E.D. preparation; it was concerned with helping its viewers cope with everyday life problems, make their reading more effective, acquire more confidence so that they may identify and work towards their own goals, improve their mathematical skills, and become interested in the possibilities offered by continuing education.(129)

The target audience for Project Strive totalled 8.2 million Americans, or 4% of the total U.S. population. Women outnumbered men in the intended audience. (31% of the projected audience were not to be in the labor force.) The "average" Strive viewer was expected to be white, living in or around a metropolitan area, and a blue-collar worker. 13% of the total projected audience were to have income below the poverty level, but the majority (66% of the men) were to have incomes between $6,000-$10,000 per year. Geographically, the audience was expected to be rather evenly divided among the northeast, mid-east, mid-west, and southern regions of the U.S. It was expected that viewership (measured as a percentage of the total viewership) would be highest in the south, lowest in the west.(129)

Strive was to be delivered to its audience in a variety of ways. Essentially, delivery was to be via public television, radio, accompanying printed materials, and personal services. Plans called for 35 hour-long national television programs, with a magazine format, to motivate viewers; 30 half-hour television programs to present elements of the basic skills (i.e., mathematics, reading) in a manner relating them to the viewer's everyday life; and radio spots of 5 minutes each to provide further orientation for the audience. The national production components of Strive were to be buttressed by locally-produced programming that would tie in national programming with the local scene. Another feature of the project was to be an attempt at national coordination through trained personnel, printed materials for management at participating stations, organization of local viewing groups, all designed to insure a two-way flow of information. Production was to be at public broadcasting facilities, and distribution via the Public Broadcasting Service and National Public Radio. According to an April, 1972 memo, Strive planners hoped to initiate the effort in Fall/Winter 1973.(129)

Project Strive was never implemented. One can only speculate as to why. CPB underwent a management change during this period. Strive was an ambitious project involving both national coordination and extensive organized local involvement. Currently, a Task Force on Adult Education of the Advisory Council of National Organizations of CPB is studying the future role of CPB in Adult Education. It would not be surprising if past interest in Adult Education as manifested by Project Strive were once again to emerge.

e) Other Uses

The primary current delivery mechanism for adult basic education appears to be face-to-face interaction with a qualified instructor. However, examples of technological delivery may be cited. Certificates of Merit are awarded to states for their implementation of adult basic education programs. Two of the FY 1970 meritorious programs are worthy of mention: 1) the State of New Mexico used videotape equipment in five centers to help the instructors assess their performance and the students assess their proficiency in English; plans are underway to expand this approach to a statewide basis, and 2) the State of California Department of Education initiated a demonstration project on centralized data compilation; operations were begun with the data processing center of a school district and a 25% sample. The purpose is to help adult basic education administrators in decision making.(14)

At the other end of the adult education spectrum one find the development of non-traditional higher education and open learning systems. The State University of Nebraska S-U-N Project and the University of Mid America aim to make opportunities available utilizing television for individuals who have often been counted in adult education surveys. (See Section IIC4b.) Continuing professional education forms a distinct subset of adult education that is making use of televised instruction. (See Section IIF.) Non credit and continuing education activities in the Stanford Instructional Television Network are reported to be important factors in that network's financial picture.(93)

4. Conclusions

Adult education has received increasing attention in recent years. Two main thrusts seem to be emerging. One is directed towards "adult basic education" or "compensatory education" and has been stimulated by federal programs aimed at improving literacy and developing skills needed to secure and hold employment. The other is more related to enrichment or continuing education for diverse segments of the population.

Enrichment or continuing education seems to be thriving. It can be acquired in a diversity of settings, from community centers to university extension divisions to the home. Public television stations broadcast a variety of courses that fall into this category. PBS, according to a 1971

Harris poll, estimates its weekly audience at 39 million. There is growing interest in the use of television for open learning systems and non-traditional higher education. A market would appear to exist in the sense that millions of Americans are currently willing to pay for enrichment or continuing education. Costs tend to be within range of many people.

Adult basic education is another matter. Here it would appear that federal and other programs have not been commensurate with the need, as indicated by the relatively small number of individuals served by such programs compared with those who are estimated to need functional literary and other skills to survive in the U.S. Although some examples of projects for compensatory adult education involving telecommunications, either implemented (RFD, KET-GED) or aborted (Strive) have been cited and analyzed, such activity does not appear to be widespread.

Public broadcasting would appear to be a key element in current and future efforts for large-scale use of telecommunications in adult education. A CPB Task Force is in the process of developing recommendations about CPB's role in this area. In the meantime, the Children's Television Workshop, creators of Sesame Street, has been developing a health education series which was aired on public television starting Fall, 1974. Further analysis of factors working for and against increased use of telecommunications in adult education may be found elsewhere.(14, 128)

F. CONTINUING PROFESSIONAL EDUCATION

1. Introduction

The information explosion places increasingly greater burdens on the working professional to maintain and advance his or her knowledge in order to prevent an atrophy of proficiency. Four professional groups, teachers, doctors, lawyers, and engineers, will be examined in this section to determine if they constitute a potential market for continuing professional education delivered via large-scale electronic technology. For purposes of this discussion continuing professional education is defined as the participation of working professionals in some kind of formalized learning procedure. Participation may be motivated by a variety of considerations and may, or may not, lead to an advanced degree. This investigation is presented with the full realization that the prospects of any one professional group utilizing telecommunications for continuing education may depend upon a combination of social and economic forces, such as mandatory periodic relicensing, additional course requirements for certification, or the economic health of supporting industry.

Some information pertinent to all the professional groups considered in this section will now be presented. This is followed by separate examination of each of the four professions of interest. The section ends with conclusions concerning large-scale telecommunications and continuing professional education.

a) Numbers and Learning Sites

In terms of numbers, professionals are not the largest potential audience. Teachers and engineers, with an estimated 2,899,000(87)* and 1,000,000 practitioners respectively,(130, 131)* are the largest of the professions studied. These are gross figures, unrepresentative of the specialties within the ranks of each profession. Estimates are for 322,228 practicing doctors(132)* and 322,723 practicing law.(133)* In addition to being relatively small and diverse, as compared with the 10.9 million preschoolers in 1970(15) or the 51.3 million elementary and secondary students in 1972,(22) the professional audience has graduated from the educational system and therefore, to a certain extent, must be reached elsewhere. Likely learning locations other than campuses are elementary and secondary schools for teachers (many schools currently having radios and televisions, at least), medical centers for doctors (emphasizing concentrations of hospitals and medical schools), courthouses for lawyers, and offices for reaching all professions except teachers. Businesses employing engineers would currently be the most likely sites equipped to receive televised instruction. Cost for equipment, participation, and software may well be borne, to some degree, by the engineering employer. The situation is less obvious for doctors and lawyers. Although there is some evidence of a clustering of medical and legal offices within urban areas,(134) presumably more of these professionals are self-employed than are engineers. Thus, telecommunications for continuing education for these groups might place the cost of receiving equipment and software upon the individual practitioner or groups of practitioners. In a "wired" environment, people could be served at home.

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*Estimates cited are for the following years: 1971 - teachers, including those engaged in post-secondary institutions and specialized settings; 1970 - lawyers (derived); 1971 - doctors; early 1970's - engineers (rounded).

b) Audience Characteristics

The professional audience collectively displays certain characteristics which serve to distinguish it from other educational markets. The elements of time available for participation, motivation, and the leadership of professional societies in all aspects of working life, may all affect the likelihood of electronic delivery being accepted by this market. The professional faces a demanding work day; time available for participation is a premium consideration. Work days are not uniform within this sector, ranging from the "all hours" working demands upon the doctor to the highly-structured days of the school teacher. Released time from work for participation in continuing education is a pattern often seen among engineers, while "fringe time broadcasts" (8 AM, noon, or 5 PM) to participating law firms are in the embryonic stage. Electronic delivery, to be utilized, will have to provide schedule compatibility and flexibility for each professional market.

Motivation of students is presumably not a problem in this case. Therefore, production values need not be elaborate; "talking heads,"* if sufficiently organized and informative, will do as will taping or broadcast of actual classes. The primary software consideration must then be one of adequate supply for this highly specialized market which is further splintered into sub-specialties within each professional sector. Content quality is very important since the emphasis is upon expanding the practitioner's working knowledge; his or her time should not be wasted. Audiences may well expand should periodic relicensing requirements become common;

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*Television parlance for an individual speaking.

literature from most of the professions mentions this possibility. However, at present such requirements are required by law in few, if any, instances.

c) Role of Professional Societies

Professional societies assume a potentially greater role for serving this market than in other educational sectors. The proclivity of professionals to form and join appropriate work-related organizations places such societies in the position of commanding a distinct membership and access to quite a few of the specialized information resources. This makes professional organizations desirable partners with established educational institutions for the evolution and distribution of software materials. Two recent examples of this type of interrelationship are in evidence: the "satellite seminar" jointly conducted by the University of Alaska and the National Education Association (national office and state affiliate) relied upon electronic delivery while the Professional Certificate program of the UCLA Extension service in Continuing Education in Engineering and Science and the local chapter of the American Society of Civil Engineers relies upon traditional classroom instruction.(148) A variation on this theme is now occurring in Washington, D.C., where the Joint Committee of the American Law Institute-American Bar Association, a professional organization, has prepared courses delivered via microwave to participating law offices.

2. Engineers

Electronic delivery of continuing professional education is currently most widespread among engineers. Within the last twelve years, 26 systems* have begun operation, emanating from universities or university consortia located in most every region of the country.(93) While commonly referred to as televised instruction, delivery is not totally electronic; accompanying written materials and professorial site visits usually augment remote lectures. Why this procedure is so relatively well-developed in the engineering sector may only be surmised: the "technological bent" of the post-War era which demanded ever-increasing expertise coupled with the prevailing practice in which initial placement did not require post-graduate training, combined to produce increasing numbers of working professionals earning advanced degrees.

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*This count represents the figure cited by the Task Force of the American Society of Engineering Education as having been "...identified and queried ..." by them in their study of the cost-effectiveness of Continuing Engineering Education by television. The Task Force was formed in January, 1973, and reported in May, 1974. (93)

a) Enrollment and Delivery Systems

A September, 1973, estimate was that 15,000 engineers were enrolled in 700 courses via electronic delivery of class sessions to off-campus work locations.(135) The Engineering Manpower Commission Enrollment Survey for 1972, cited by Alden, tallied 36,337 full-time and 24,940 part-time graduate engineering students.(136) Thus, based upon these statistics, televised instruction has become a significant factor in continuing engineering education. Heavy part-time inputs to education undoubtedly contribute to this situation, with between one-third to one-half of all engineering graduate students falling into this category.(135, 136) An extensive study by Wong, which included a survey of directors of technology-based networks, indicates that acceptance of televised, off-campus instruction in this field is due to a variety of factors, including the convenience of not having to commute to campus for one course, and industry's willingness to support such activity financially.(19A)

Generally, for the engineering systems, choice of delivery mode--videotapes physically delivered to each location, ITFS, or microwave transmission--will be dictated by cost considerations which depend upon the geographical distribution and population of the target audience. Videotapes serve a broadly-based constituency such as the Colorado State University system reaching students in four states. ITFS serves many locations within a concentrated area, such as the Stanford Instructional Television Network, in the greater San Francisco Bay area. Microwave serves to connect widely distant points such as in the Oklahoma State system which uses microwave to reach area ITFS systems;(93, 135) Morris, et al. have performed a series of calculations illustrating tradeoffs between videotape and radio-frequency systems and pointing out the necessity for careful comparisons to be made to insure selection of the lowest cost system.(93)

b) Cost Analyses

Figures cited by the Task Force of the American Society of Engineering Education studying televised delivery of continuing professional education indicate a lower per-student-per-hour instructional cost for off-campus electronic instruction than for similar on-campus instruction. For the Colorado State University system SURGE, estimates for the 1972-1973 school year are $4.16 for off-campus education and $6.50 for on-campus instruction. For the Stanford University system comparable figures are $3.26 for off-campus education and $6.47 for on-campus instruction.(93) These analyses are based upon the incremental costs of off-campus instruction, and do not charge any of the salary of the on-campus instructor to the off-campus costs. Tuition charges are normally the same for off-campus as for on-campus instruction. An additional television surcharge is sometimes assessed the participating industrial organization. The latter is clearly an important factor in supporting such systems networks, both in the initial investment stages and during operations.

Survey results of the ASEE Task Force indicate that one out of thirteen respondents was recovering all costs associated with its system operation. An important contribution factor to the solvency of this system was the admission of auditors, students not working towards a degree, and the involvement of colleges and universities other than the primary sponsor. These inputs served to swell the number of participants and lower unit costs. The Task Force suggests ways of extending system use still further by offering an MBA degree or business-related courses.*

3. Doctors

The physicians' market for continuing professional education via telecommunications is now being served by a well-developed professional organization and institutional infrastructure yielding software production and outlets. During 1971-1972, 2,354 continuing medical education courses were given by 292 separate organizations; 38% were given by medical schools, 26% by hospitals, and presumably the lion's share of the remainder were given by professional organizations.(137)

Wide-ranging dissemination systems include the computer network linked to the National Library of Medicine, the Medical Education Television Network serving the state of Indiana, videotape circulation, and satellite demonstrations. Medline, one service of the National Library of Medicine, provides for interactive computer searches and retrieval of most of the biomedical journals cited in Index Medicus. Master data bases are accessed by more than 200 user terminals in 47 states (including Alaska and Hawaii), 8 Canadian provinces, and 4 foreign countries (England, France, Sweden, and Brazil). Telephone lines or transoceanic cable routinely provide the interconnection. Users include medical schools, hospitals, biomedical research institutions, and government agencies in health-related fields; they become part of a remote computing network operated by Tymshare, Incorporated.(138)

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*The Indiana Higher Education Telecommunications System serves a variety of audiences ranging from paradental training to specialized programs in medical practice. The user base is broadened, but all training remains within the university rubric. (150)

State-wide coverage is provided as part of the Indiana Medical Educational Resources Program (MERP), operated by the state university medical school. A television network reaches 7 campuses, 24 hospitals, and - in limited instances - physician's private homes.(139, 150) Circulation of videotapes and videocassettes is not uncommon; MERP includes the Medical Videocassette Mailing Network reading 62 Indiana hospitals, while Brooke Army Medical Center in Texas will duplicate requested items for non-profit health institutions with the provision of a videotape.(139, 150)

Programming has been, and will continue to be, distributed via satellite. "Recent Advances in Psychotherapeutic Drugs" was the topic of a January, 1973, closed-circuit television seminar linking New York and London-based panelists with doctors in ten American cities. Satellite distribution made possible interactive communications between physician-panelists and participants. The session was privately produced, financed by a pharmaceutical manufacturer, and conducted under the aegis of the Royal College of Psychiatrists and the American Psychiatric Association.(140) Ten Veteran's Administration Hospitals throughout Appalachia are currently participating in the ATS-6 satellite demonstration. They receive weekly videotapes from Denver on topics of continuing medical and paramedical education. Teleconsultations[*] will be possible between Appalachian-based physicians and Denver-based specialists.(141) Additional experimentation in both medical and dental education is planned for the CTS satellite to be launched in 1975.

4. Teachers

Current interest in using large-scale technology for on-going pedagogical education centers on reaching expanded professional audiences so that problem areas may be addressed and specialization shortages assuaged. Two instances of regional satellite demonstrations illustrate university-professional society cooperation, the utilization of intrastate coordinating agencies, and a willingness on the part of some universities to credit courseware produced elsewhere on subjects they are unable to provide.

During the 1973 spring semester (January-May), the University of Alaska College of Education, the National Education Association (NEA), the Alaska-NEA, and a participant's panel representative of the state's rural teachers, collaborated to produce a seminar dedicated to issues faced by the state's rural teaching corps. Statewide radio broadcasts in real time reached 17 isolated villages. The ATS-1 satellite also provided interactive audio capability on a point-to-point basis within the state and between Alaska and Washington, D.C. Interactive capabilities were used during the question and answer period which concluded each weekly broadcast. Attendance, like audience reaction, varied ... although six teachers completed the seminar for one unit of credit from the College of Education. Cost data is sparse;

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[*] Teleconsultations may be considered one facet of telemedicine, or the use of telecommunications in the practice of medicine. Although telemedicine is excluded from this discussion, the distinction between it and continuing medical education is not always precise.

by "piggybacking" on extant hardware, expenses for the seminar essentially consisted of staff time and services to plan, coordinate, and participate in the programming.(142)

Demonstrations are continuing: Alaska, the eight state Rocky Mountain region, and counties in eight of the twelve eastern states considered in "Appalachia,"[*] are now being served by the newest experimental satellite ATS-6. Appalachia will devote its entire educational component to in-service teacher training. Television programming developed by the University of Kentucky on career education and elementary reading will be beamed to 1,200 teachers meeting at 15 sites throughout the region. Coursework will be awarded graduate credit by the developing institution and cooperating universities throughout the coverage area. In addition to one-way programming, there will be live seminars, computer-managed instruction using land lines for access to remote data banks of relevant teaching materials, and programmed instruction. Participating teachers will attend a 6-week summer session with 16 seminars during the school year. Funding has come from a $2.2 million grant from the National Institute of Education (NIE), and is coordinated by the Appalachian Regional Commission (ARC). Monies were allocated so that approximately 1.5 million went to the University of Kentucky for program development and evaluation, and $700,000 went to the ARC and training sites for administrative expenses.(143)

Plans of the Alaska and Rocky Mountain regions are to serve a broader audience with their satellite time for education. Alaska hopes to provide in-service training to education paraprofessionals and professionals.(144) The Rocky Mountain states are planning to beam career education programming into the schools; professionals involved with the in-service component will be the staffs of the 56 rural junior high schools which are equipped to receive satellite transmissions. This audience should average 600 and will receive pre-service instruction during the late summer of 1974 plus two semesters (32 weeks) of in-service training during the coming school year. Instruction will largely rest with 16, 55-minute, originally-produced broadcasts; no graduate credit will be awarded to participants. Funds for this, the largest regional component, have come from the NIE and are channeled through the Federation of Rocky Mountain States (FRMS), the Denver-based consortium handling planning and operations.(144, 145) (See Section II.C.4.e.)

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[*] Regional participants by state are: 1) Alaska, to be linked with Washington State for some demonstrations, 2) Rocky Mountain area: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, and 3) Appalachian area: *Alabama, Georgia, Kentucky, *Maryland, *New York, *North Carolina, Ohio, *Pennsylvania, South Carolina, *Tennessee, *Virginia, and *West Virginia, of which the *marked states are participating. (143)

5. Lawyers

Use of non-print media for continuing legal education is in evidence, although not to the extent as in the other professions. Two recent efforts to use electronic technology for this purpose have come from two organizations devoted to continuing legal study. The Practicing Law Institute (PLI) has created a 15-hour videotape course on the problems confronting counsel for a company going public.(146) The Joint Committee of the American Law Institute-American Bar Association has developed three television series, each serving as a 14-week survey course. Initiated in the spring of 1974 in the Washington, D.C. area, the Joint Committee is using microwave facilities to transmit the programs to subscribing law firms within a 20 mile radius. Priced at $250.00 per course per firm (attendees unlimited), those equipped with the requisite antenna, installed by the microwave company, may receive transmissions then routed over direct cable or the building wiring system; distribution and receiver costs, if any, are borne by the law firm. Participation requires one hour per week; scheduling is during off hours (8 AM, noon, 5 PM) so that office time is not lost.

A cost-benefit breakdown prepared by the Joint Committee indicates a cost of $17.85 per student per hour, or the quotient of tuition divided by instructional hours. Essentially these are the only costs seen by the Joint Committee, since there are no travel expenses or loss of billable working time. Based upon this procedure, the cost to the firm would decline as more employees enrolled. This situation is contrasted with the normal off-site workshop method of continuing legal education where expenses increase as more lawyers per firm enroll. The traditional method requires travel expenses and loss of billable working time, which should be added to tuition when figuring cost for each participant.(147)

6. Conclusions

Many of the professions studied are in varying stages of commitment to, and experimentation with, electronic delivery systems for continuing education. It is worth noting that not all suppliers are educational institutions; indeed, professional societies and private enterprises as well as universities are involved in serving this market. Actual widespread adoption of electronic delivery may hinge upon factors such as the extent to which relicensing and recertification requirements become accepted, the cost-effectiveness of the technology, and the relative affluence of supporting industry and individual practitioners.

Technology-based networks for delivery of televised graduate engineering instruction to off-campus industrial locations has emerged as a significant factor in this field. Most of these systems use ITFS, microwave or videotape delivery. Although generally serving a single state or localized region, a recent survey conducted by Wong(19A) indicated that a majority of network directors were interested in exploring the possibility of involvement in an expanded regional or national network arrangement.

The medical profession, although having a relatively small number of practitioners, is generally able to muster resources needed to make use of new technology. Continuing medical education is an on-going, well-established activity. Medical television and computer networks are coming into being which can not only aid in continuing education but play an important supportive role in medical practice and research. Continuing medical education experiments are being carried out on the ATS-6 satellite. A continuing dental education experiment has been conditionally approved for the CTS satellite.

Of all the professions studied, teachers are the most numerous. Continuing teacher education experiments figure prominently in the ATS-6 satellite experiment. However, the financial base in this sector is probably less solid than for engineering or medicine. The legal profession has used videotapes and microwave transmissions to a limited extent in continuing education but is probably the least likely to make use of large-scale telecommunications at this stage.

Although not continuing education in the usual sense, professions have another, perhaps more pressing need that large-scale electronic systems may satisfy: information-on-demand would be of benefit to all professions studied within this section.(134) Two working examples are the

Medline system operated by the National Library of Medicine and an auxiliary service provided by the Appalachian Educational Satellite Project in which computer searches for participating teachers will be conducted of remote data bases.(143) The tradeoffs between large-scale systems and local systems requires further investigation.

G. EARLY CHILDHOOD EDUCATION*

1. Introduction

A pedagogic specialty of growing interest in recent years, early childhood education is concerned with the child during his youngest, most formative years prior to the mandatory school entrance age of either five or six. Therefore, instruction at this level need not take place in a formal school setting; most early childhood education occurs in non-traditional settings such as the home, care centers, or nursery schools. Day care, or child care services, refers to the concept of a non-related adult caring for the child; this too may take place in a variety of settings ranging from institutional arrangements to care in a private home, other than the child's own, the latter setting referred to as a family day care home. Early childhood education and day care are not mutually exclusive; day care may include educational services, and pre-primary educational programs may include additional services for the child, such as meals and medical examinations. A distinction may occur over the age group served by each: "early childhood education" usually implies a clientele between 3 and 5 years old, and "day care" clientele is somewhat weighted in favor of those 3 and under.

2. Statistics

As of 1970, there were more than 17 million Americans between the ages of 0-5, who may thus be viewed as potential participants in either early childhood education or day care. During that year, 4.1 million 3-to-5 year olds were enrolled in preprimary educational programs. As of 1969, 518,000 children were in day care centers and 120,000 youngsters were in family day care homes. The 1969 figures should be viewed as minimum figures for each institutional arrangement.(15)

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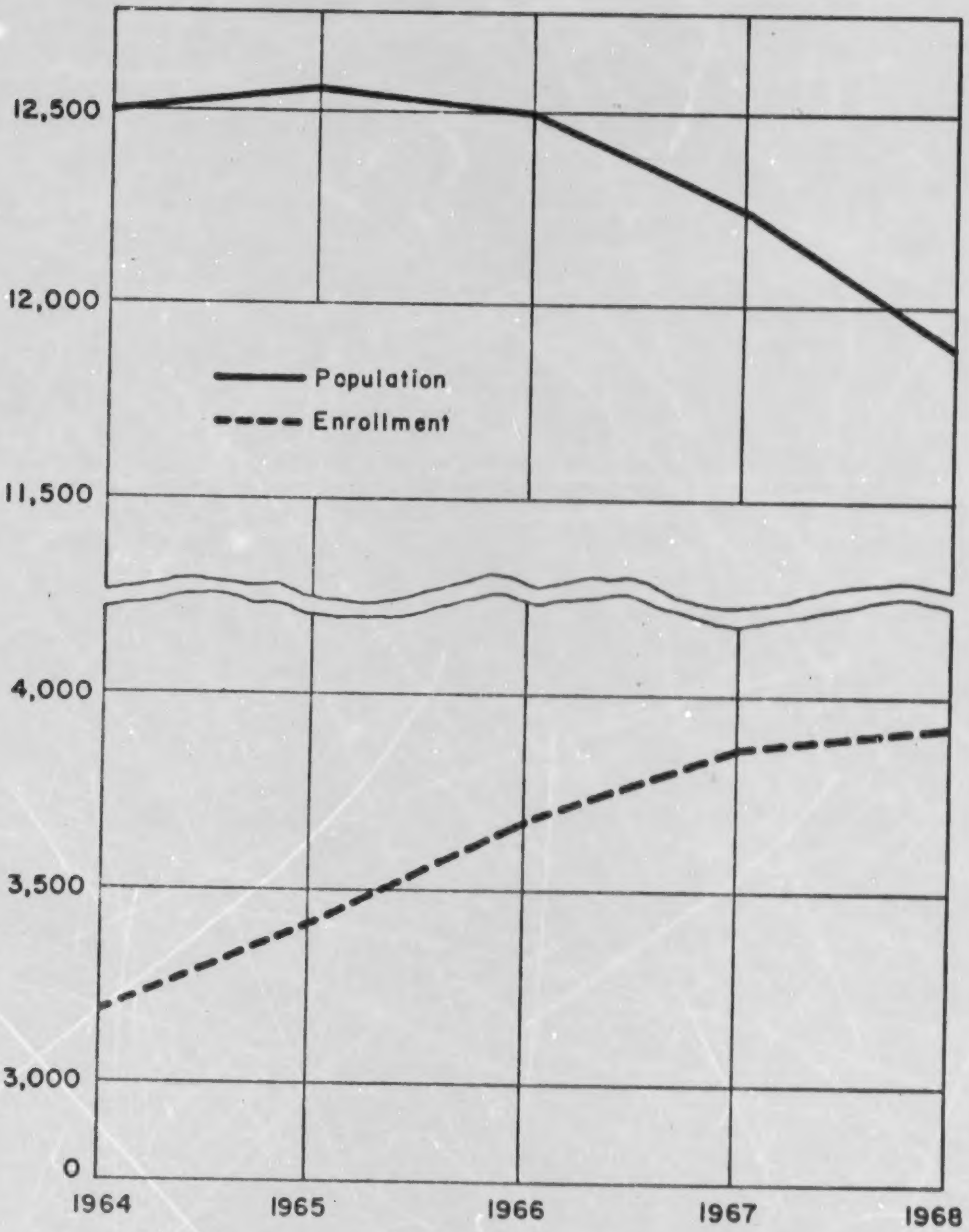
*This section is based primarily on a study by Rothenberg dated May, 1973. Additional supporting references may be found in the study report. (15)

Information on early childhood education trends in the 1960's is shown in Figures 10 and 11. Figure 10 indicates that early childhood education experienced growth in participants despite a decline in the total number of Americans in the early childhood age bracket during the 1960's. During the period between 1964 and 1968, enrollment of nonwhite 3 to 5 year olds rose more sharply than for whites. Figure 11 summarizes preprimary (ages 3, 4 and 5) enrollments, total population of these ages, and percentages enrolled by region for October, 1970. At that time, the eligible population was located roughly in a 4:4:3 ratic according to Metropolitan, other: Nonmetropolitan: Metropolitan central areas. Percentage enrollment within urban poverty areas exceeded that for the remainder of the nation.

3. Markets for Early Childhood Education

There are 3 markets for early childhood education. The first is comprised of the youngsters themselves. Instruction for this market is designed to impart rudimentary cognitive skills, such as language acquisition and basic concepts for working with numbers or necessary affective skills, such as the ability to work within a group. Materials currently abound for servicing this market, ranging from the televised instruction of "Sesame Street" or "Mister Roger's Neighborhood" to print and records, as evidenced by non-broadcast materials designed by the Children's Television Workshop. Although there has been a great deal of effort to produce educational materials for this market, much of this material has not been initially designed for electronic dissemination.

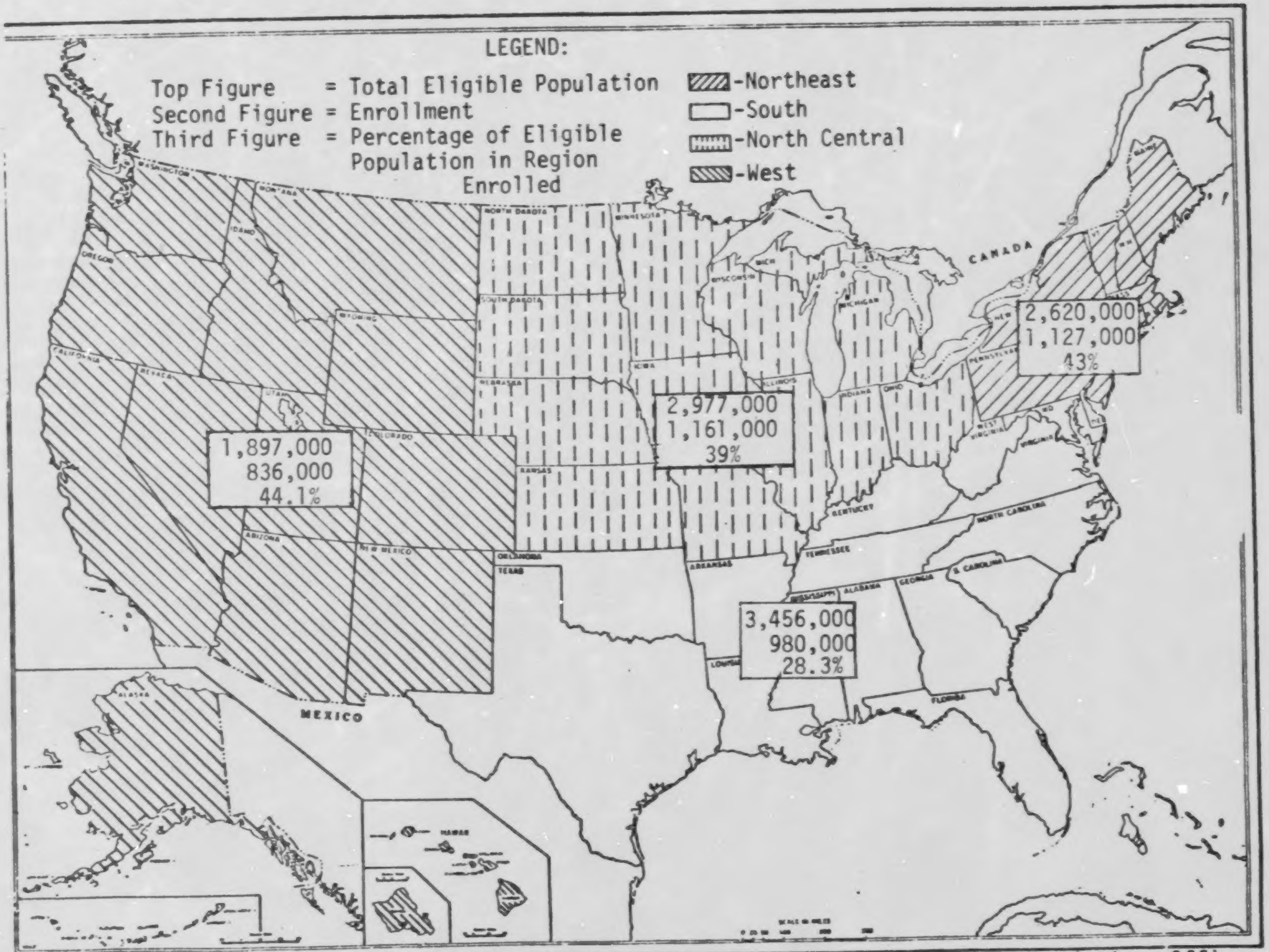
The second market for early childhood education is comprised of parents of pre-schoolers. Only recently, with renewed attention to early childhood services, has this market been identified as such. Educators have recognized



Source: Preprimary Enrollment Trends of Children Under Six, National Center for Educational Statistics, Office of Education, U.S. Department of Health, Education, and Welfare, Washington, D.C. (1970)

FIGURE 10

PREPRIMARY ENROLLMENT AND POPULATION OF CHILDREN 3 TO 5 YEARS OLD: UNITED STATES, 1964-1968.


LEGEND:
Top Figure = Total Eligible Population
Second Figure = Enrollment
Third Figure = Percentage of Eligible Population in Region Enrolled
▨-Northeast
☐-South
▥-North Central
▨-West
CANADA
MEXICO
1,897,000
836,000
44.1%
2,977,000
1,161,000
39%
2,620,000
1,127,000
43%
3,456,000
980,000
28.3%

Source: Preprimary Enrollment, October, 1970, National Center for Educational Statistics, Office of Education, U.S. Department of Health, Education, and Welfare, Washington, D.C. (1971).

FIGURE 11: PRE-PRIMARY ENROLLMENT BY REGION, 1970

the need to instruct many parents in the desirability of preparing their children for meaningful schooling by working with them while at home to lay the groundwork for cognitive and affective skill acquisition. Strategies include awakening the parents to the possibilities inherent in toys for educational play and providing follow up for instruction to insure retention. Parental instruction may take place in specially-designed groups, such as the Toy Lending Library, or through home visitation in conjunction with televised instruction, as exemplified by the preschool program of the Appalachian Educational Laboratory.

The third market for early childhood education is composed of the operating staff of early childhood services programs; this would include professional teachers and administrators, paraprofessional aides, and volunteers. The extent of this market is difficult to quantify. Its potential may be surmised by U.S. Department of Labor projections which anticipate a need for 23,000 child care workers annually during the eight years between 1972-1980. It is assumed that 5,000 early childhood educators will be graduated from teacher training institutions each year; therefore, the remaining 18,000 spots will be filled by recruitment and upgrading of paraprofessionals. Instruction at the paraprofessional level may include the rudiments of effective child care as well as course work that could be credited towards professional certification. Programming could be devised to keep professional early childhood educators and administrators current of developments in their field.

4. Costs

The costs attached to early childhood education or services are highest for group-based activities for children. The most expensive settings are family day care homes and day care centers; operating costs will be at least $2,000 annually per child assuming a comprehensive care program including education. Other center-based programs and their 1970 costs are as follows: Head Start - $1,050 per child; Kindergarten - $900-$1,700 per child; in school pre-Kindergarten - $200-$780 per child. Approaches in the moderate price range include home visitation by a trained paraprofessional for parent training, the pre-school program of the Appalachian Educational Laboratory and center-based parent training programs. The Appalachian Educational Laboratory pre-school program, in which electronic dissemination has been used, costs $242.15 per child for televised instruction, home visitation to provide parent training, and regularly scheduled group activities for children. Televised instruction for either parent or child is the least costly option. "Sesame Street," a celebrated example of direct-to-home pre-primary instruction, is estimated to cost $1.00-$1.29 per child per year.

Such costs seem to place the initiative for extension of early childhood education and/or services at the grassroots level. Therefore, public support will be a function of public perception of need. Trends seemingly favorable to this include the amount of attention and discussion about early childhood education in the public arena, reassessment of the economic role of women, interest in welfare reform, and arguments for preventive rather than remedial education. If public feeling continues to be receptive to extension of early childhood education and/or services, this should be with full realization of the need for a sizeable financial commitment. Extension of early childhood education may then become greatly reliant upon the feasibility of delivery quality services in a cost efficient manner in order to fully satisfy the American public in this age of accountability.

5. Uses of Technology and Telecommunications

a) Introduction

Technology and telecommunications applied to the field of early childhood education usually means television, at least in the large-scale sense that we are concerned about in this study. Computer-aided instruction is usually not thought of as an instructional tool in a pre-school setting. Smaller-scale technologies (film projectors, cuisinare rods, books, etc.) are found in various early childhood centers.

Educational programming is available on both commercial and public television outlets to serve the preschool audience. The following examples are some, but not all, of the preschool programs provided by the television networks. Also included is a discussion of the Appalachian Educational Laboratory's pre-school program, and of programming for parents of preschoolers.

b) Commercial Television

CBS regularly broadcasts "Captain Kangaroo," a program specifically designed for pre-schoolers, on a five-day-a-week basis (9 A.M,, E.S.T.). During the spring and fall of 1972, 3 1/2 minute filmed and animated inserts highlighting cognitive and affective objects appeared as part of the program. The segments were a joint venture of the Department of Health, Education, and Welfare, the CBS Television Network, and Sutherland Learning Systems.(151)

NBC-TV has offered "Watch Your Child," a program fusing education and entertainment for pre-schoolers. "Watch Your Child" regularly features a video insert showing the aural portion translated into sign language for deaf viewers.(152, 153)

ABC-TV provides children's programming with an educational component. However such programming may be designed for a more inclusive audience than just pre-schoolers. Examples include the Saturday morning "Scholastic Rock" segments which are 3 1/2 minute mini-lessons and the monthly "ABC After School Special."

However, children's programming on commercial networks does not elicit universal comments of contentment and delight. Action for Children's Television (ACT), a Massachusetts-based group, is developing a national constituency with its demands for more responsible children's shows from commercial broadcasters. Frequently-voiced complaints concern ubiquitous commercials and constant violence in programs designed to attract the child audience. An ACT poll published in 1973 in conjunction with Parade Magazine and the Boston University Department of Communication Research, discovered similar sentiments from a nation-wide response representative of many demographic groups. Table 11 lists the twenty television programs watched most often by the respondents' children or siblings.(154) An interesting feature is the strong showing of Public Television offerings, which may serve to elicit new interest in improved children's programming on the part of commercial broadcasters.

c) Public Television* and Sesame Street

It may well be that in many people's minds, public television is

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*Public radio does not, at this time, provide programming for early childhood education.

TABLE 11

Action for Children's Television Poll Revealing the 20 "Most Watched" TV Shows by Children

THE TOP 20

A total of 6961 different programs were listed in answer to the question "Which programs does your child watch most often (list up to five)?" Following are the 20 most frequently named, with the percentage of respondents listing them.

	PROGRAM	PERCENTAGE
1.	Sesame Street	62.4
2.	Electric Company	40.6
3.	Mr. Roger's Neighborhood	36.2
4.	Captain Kangaroo	22.8
5.	Walt Disney Presents	20.6
6.	Flintstones	18.6
7.	Brady Bunch	14.1
8.	Partridge Family	10.0
9.	Lassie	8.3
10.	Gilligan's Island	8.0
11.	Zoom!	6.8
12.	Speed Racer	6.6
13.	Romper Room	6.2
14.	Wild Kingdom	6.2
15.	New Zoo Revue	6.1
16.	I Dream of Jeannie	5.9
17.	The Waltons	4.8
18.	Emergency	4.5
19.	I Love Lucy	4.5
20.	Mouse Factory	4.5

Source: Herbert Kupferberg, "What *You* Think of Children's TV," *Parade*, March 4, 1973.

synonymous with one pre-school television series, namely Sesame Street.* This show, designed for pre-schoolers by the Children's Television Workshop, is perhaps the most-researched children's television program. Its educational component was designed to teach measurable cognitive skills which would enable the viewer to go to kindergarten prepared with a helpful skill repertoire. The Educational Testing Service was engaged by the Children's Television Workshop to conduct follow-up studies on the effectiveness of "Sesame Street" in achieving its educational goals. By May, 1973 results for the first two seasons, 1969-70 and 1970-71, had been published.(155, 156)

Generally, one point has emerged from these two ETS studies of "Sesame Street": the more the child viewed "Sesame Street" the more he would learn. Encouragement to view, and reinforcement of the program's objectives, were aids to viewing and learning. The research determined that advantaged viewers had a tendency to watch the show more often than disadvantaged viewers; efforts were made to equalize effectiveness by encouraging viewing and reinforcing learning objectives among the disadvantaged population.

Data for the premiere season, 1969-70 were amassed from the target audience of at-home pre-schoolers. The research sample consisted of 943

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*Other programs do exist. For example, "Mister Roger's Neighborhood" is intended for children ages 3 through 6. This program deals with affective development in children by trying to promote social growth and personality development. A 1972 study prepared for The Interagency Panel on Early Childhood Research and Development by Searcy and Chapman described the content of "Mister Roger's Neighborhood" as consistently involving: learning, emotional expression, concept of self, play, and relations with others.(157) The program is aired weekday afternoons. "The Electric Company," produced by Children's Television Workshop attracts a pre-school following although intended for a primary grade audience.

3 to 5 year-old children, of which 731 were considered disadvantaged. Data was gathered in part by pretesting and post-testing this sample.(155, 156) Other distinctions made regarding the sample were: Spanish-speaking children (sample = 43) and rural children (sample = 61). The data indicated that all viewers educationally profited from the experience, with those profiting the most who viewed most frequently. A tentative finding was that the Spanish-speaking were the biggest gainers if they viewed frequently. Rural children made great gains.(155) Follow-up data indicated that "there were no significant differences between the gains of disadvantaged white children and disadvantaged black children."(156)

The data from "Sesame Street"'s second season, 1970-71, was generated by a sample heavily-weighted by disadvantaged children. Data was again collected, in part, by pre-testing and post-testing the subjects. 632 constituted all those who completed the full research cycle. The target audience was the disadvantaged pre-schooler whether at home or at school, for by this time some members of the original "Sesame Street" class had entered the ranks of formal education. The cognitive goals of the show had changed, ruling out specific categorical comparisons. However, some interesting findings emerged. Steady viewing increased the show's effectiveness; so did encouragement, or the act of encouraging a potential viewer to actually watch the show. It had previously been determined that advantaged viewers had a tendency to watch the show more often than disadvantaged viewers. The encouragement factor, therefore, had implications for utilization and field staffs; how could the disadvantaged, that segment most in need of the "Sesame Street" format, be encouraged to watch and benefit from it?(156)

The first year's tentative findings regarding Spanish-speaking viewers remained tentative. Data for year number two included a Spanish-speaking sample of 66. No findings were generated when the control group failed to function, and a comparison group of non-viewers failed to materialize. The Age Cohorts Study indicated that consecutive two-year viewers demonstrated greater mastery of more complex tasks. Viewers for whom "Sesame Street"'s second season represented their first year in school did not "turn off" to formal education as hypothesized by some.(156)

Efforts are made to provide adjunct services which complement "Sesame Street" programming, hopefully enhancing its effectiveness. The Community Education Services Division of the Children's Television Workshop functions to create ways to increase viewership and usage of CTW shows. The Division's efforts are largely focussed on rural areas, inner-cities, and non-English speaking communities. Implementation of these strategies rests with the Field Services Department of CTW. Through field coordinators at seven regional offices, CTW seeks to form working relationships with local community groups, a priority goal being the establishment of viewing centers. The Program Development Department, another component of the Community Education Services Division, exists to provide guidance and materials to any organization interested in using CTW products to further children's education. The Program Development Department is also charged with the development of additional program approaches necessary to facilitate community involvement.(158, 159)

Such services are in the form of follow-up work via person-to-person delivery. The intent is to reinforce the academic lessons of the show. The mechanism may vary. The parent may be trained to administer materials devised by Children's Television Workshop or to create his own. Perhaps the children will view in a group setting and have the lessons reinforced by paraprofessional volunteers. However the mechanics are designed, the point is not to let the TV show stand or fall on its own, but to insure some follow-up in hope of enhancing the educational component of "Sesame Street."

Examples include the Children's Television Workshop - Neighborhood Youth Corps summer project, which completed its second year of operation during 1972. NYC enrollees are trained to lead and devise reinforcement exercises for "Sesame Street" viewers. In 1972, the project spread nation-wide, expanding to 33 locations.(158)

Another community project emanates from the CTW Appalachian Field Service Office in St. Paul, Virginia, and is referred to as the Appalachian Project. The District Coordinator selected 40 mothers with viewing age children. All of the mothers watched "Sesame Street" with their children and reinforced the program's lessons by following taped instructions and using supplementary materials supplied by CTW. 20 of the women received additional training at periodic workshop sessions at which the emphasis was upon utilizing common household articles to construct learning materials for their children. The remaining 20 women received similar instructions over audio tape. Both groups of mothers were able to make instructional materials from easily-accessible items. Statistical analyses were not run on the Project, but continuation and participation rates were high. Mothers participating indicated a willingness to serve as neighborhood clinicians for their neighborhoods.(160)

How this additional at-home/at-center component affects the total cost of CTW programming is not known. It has been noted that the initial cost of "Sesame Street" "may be as low as $1 per year per child." More recently, former U.S. Commissioner of Education Marland quoted a $1.29 per-child per-year price tag for "Sesame Street."(161) Either figure would still place televised "Sesame Street" instruction within the low-cost options for early childhood education. Excluding the follow-up component of the design, the CTW "Sesame Street" budget is divided so that the lion's share - 70% - goes for actual program production. The first year of production, with 130 hours of programming, yielded the "rule-of-thumb" cost figure of $40,000/hour of program production. The remaining 30% of the budget was divided so that 10% went for distribution and 20% for administration and research.(162)

The follow-up component for "Sesame Street" seems to be heavily reliant upon training paraprofessional volunteers, or workers paid by another source.* Training and training materials are provided by the CTW staff. However, the majority of "field workers" would seem to be trained volunteers of parents, so the additional cost to CTW may be centered in the staffing and operation of the Community Education Services Division. The funds for supportive activities emanating from this division may not represent an "add on" cost, but rather a portion of the funds available for administration and operation as divided among the various divisions of CTW.

"Sesame Street" by many measures was a resounding success. Foreign language versions for overseas markets abound and books, records and assorted paraphernalia are sold in many stores. Those interested in promoting more extensive use of educational technology find it to be the "breakthrough" they have been waiting for. And in many ways, it is a breakthrough.

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*For example, the Summer Project enrollees paid by the U.S. Department of Labor's Manpower Administration received approximately $40 per week for their work during the summer of 1972. The total budgeted by Manpower Administration was $2.5 million. (163)

But successes are not without their problems. In the case of Sesame Street, questions have been raised about the long-term social-psychological impact on young children of programs that use high-powered techniques borrowed from commercial television to teach letters and numbers - the same techniques that make the program so popular. Minority groups have bridled at the garbage can-by-the-stoop setting at the same time that the State of Mississippi initially refused to let the program in. The Children's Television Workshop has financial needs like all organizations. Government and foundations like to fund innovative programs for limited periods of time. What happens in the long run is another matter.

The fact remains though that an educational television program designed for a pre-school audience distributed by public television received wide acceptance and acclaim, while demonstrating the economies of scale of large-scale telecommunications delivery that planners have been writing about for years. Sesame Street is a tough act to follow. Although a CPB Task Force is currently studying what the Corporation should do in the future in early childhood education, it might be that future program development will look for other educational sectors in which to produce new breakthroughs.

d) Appalachia Pre-School Education Program

The Appalachia Pre-school Education Program is oriented towards the at-home rural pre-school audience ages 3 to 5. It was designed by the

Appalachia Educational Laboratory and has served an eight-county area of West Virginia. The Appalachia Pre-school Education Program is designed with three component parts: 1) a television program entitled "Around the Bend" which is seen 5 days a week, 2) a weekly in-home visit by a trained paraprofessional to reinforce the concepts presented over TV, and 3) a mobile pre-school classroom that makes weekly visits to specified locations throughout the viewing area to give viewers reinforcement within a classroom setting.

Studies of the project divided the sample into four groups: 1) those children who watched the daily TV show, were visited weekly by a paraprofessional, and attended the weekly mobile classroom (TV-HV-MC), 2) those children who viewed the TV show and received a weekly home visit (TV-HV), 3) those children who watched "Around the Bend" only, and 4) a control group exposed to none of the preceding options. Based upon a curriculum-specific testing instrument, the Appalachia Preschool Test (APT), administered during the third year of field testing (1970-71), the general findings of the previous two years were upheld. The television programming presented the basic curricular material which is enhanced by the paraprofessional's weekly home visit to reinforce the academics. The mobile pre-school classroom yields no appreciable effect unless it was visited often enough by the viewer. "Often enough" may be construed as greater than 60% of the time.(164)

A cost analysis yields the following figures based upon a projected audience of 25,000. The costs for developing the curricular part of the project, including production of the televised component delivered over broadcast facilities, were $204,410 or $8.18 per child in operating costs,* and $1.50 per child in related capital outlay. The television component was videotaped and circulated among cooperating commercial television stations; interestingly, an additional $25,500 would allow simultaneous regional broadcast.(164)

The materials development and operational cost is unrelated to the number of users. More related to the number of users is the cost of field testing. However, the Appalachia Educational Laboratory again figured field testing costs in terms of 25,000 users. The personnel requirements for 25,000 children would be: 167 certified teachers, 167 aides, and 667 paraprofessionals. The paraprofessional home visitor, the largest personnel requirement, would be paid an average of $3,500 - the same rate as is paid the aides. The total operational cost for field operations, projected to cover an assumed 25,000 users, would be $6,053,831.00. Prorated over 25,000 users, the per child cost is $242.15.

Total costs, per 25,000 users are: total operational cost - $6,258,241.00** for a figure of $250.33 per child, while the total capital outlay ran $2,747,000 which, amortized over a 5-year period, amounted to $21.98 per child. These figures are compared to the cost of a standard kindergarten education which was $496.00 per child in West Virginia during the 1969-70 school year. The capital outlay involved in the standard kindergarten setup is 7.5 times greater than the capital outlay for the Appalachia Pre-school Educational Program.

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*Operating costs are also derived from actual operating expenses. Therefore, program production cost per hour was $100 at prevailing West Virginia prices. Replication of this program model would have to be figured at prices prevailing in the specific region interested in implementing a similar project.

**Total operational cost is the sum of total operational cost for field operations ($6,053,831.00) and total operational cost for curricular preparation --materials and telelessons--($204,410.00).

e) Programming for Parents of Preschoolers; CMREL Program

The field work done by Children's Television Workshop and the Appalachia Educational Laboratory indicate that effort must be made to follow up preschool telelessons in the home. Therefore, a legitimate target audience within the early childhood education market is the parents themselves. Not only do the parents watch the preschool programming with their children, but broadcast affords an opportunity to reach the parents directly and introduce them to helpful techniques for working with their children.

Such a program was being developed by the Central Midwestern Regional Educational Laboratory in Minneapolis. The target audience is mothers of infants and preschool age youngsters who have limited educations and fall into the lower socio-economic class. The delivery mechanisms are a series of half-hour broadcasts and a programmed text specially constructed for use by parents of low educational attainment. Both the broadcast and the programmed text are to be used together, but each may be used independently. The intent is to teach mothers ways of reinforcing their children's positive behavior. It is hoped that this strategy would then be carried over by the mother to make the home environment more conducive to learning and enrichment.

The entire package seeks to involve the audience, either through response to the programmed text, entitled Teaching Your Child, or through response to the simulated situations portrayed on the television program. Field testing thus far conducted has been with two types of populations: 1) two groups of inner-city parents, and 2) a group of rural parents. The object of the testing has been to ascertain audience reaction and to determine needed modification. An anticipated spin-off of the project will be a text, for professional educators, of limited publication, entitled "Strategies for the Design of Parent Training Programs: Intellectual Stimulation and Motivation of Young Children." The project prototype was completed and tested as of October 15, 1972.(165)

6. Conclusion

There appears to be considerable potential for using large-scale electronic technology to deliver material applicable to early childhood education. The prospects are particularly favorable for television, whether the medium is used individually as in the case of "Sesame Street" and delivered to the individual home, or in conjunction with person-to-person reinforcement as in the work of the Appalachian Educational Laboratory. The use of trained paraprofessionals for person-to-person reinforcement by many early childhood education programs delivered in various ways highlights the need for effective training procedures. Mediated instruction for early childhood paraprofessionals may provide quality instruction in a cost-efficient manner, and should be more thoroughly explored. Less clearly defined are the prospects for interactive electronic media, particularly two-way audio and interactive television, to service the three early childhood education markets. The establishment of accessible computer data banks on early childhood materials and services is a potential development.* Although early childhood programmers are now investigating new delivery mechanisms and designing a variety of media-personnel mixes, the quality of the final project will also depend upon the caliber of the programming. Program quality will be an important factor in determining whether the potentialities of electronic media will be used or misused.

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*These developments were originally planned to be a part of the ATS-F HET Satellite Demonstration in the Rocky Mountain area, but were never implemented.

H. EDUCATION OF THE HANDICAPPED CHILD*

1. Introduction and Statistics

Instruction of the handicapped child, or "special education," is part of a broader field of education dealing with exceptional children, or children with non-normative characteristics. Special education seeks to prepare the handicapped student, to the best of his abilities, for as much integration as possible with the total community. This is done academically, and to an increasing extent, occupationally. The handicapped student body is heterogenous, and evidence indicates that appropriate special education programs do not reach all potential students. Only 43% of all children thought to be eligible for special education were estimated to be receiving it as of 1971. Special education seems to be more prevalent in metropolitan areas although all states have programs.(16)

The population of handicapped youngsters in the United States has been estimated at approximately 10% of the total child population under age 19; this figure holds for the school-age handicapped population in comparison to the total student population between ages 5 and 19. As of 1968, 7,083,500 American children between birth and 19 years of age, out of an estimated 75 million, were estimated to be handicapped. 1969 estimates indicate 6,056,800 handicapped youngsters of school-age, that is, between 5 and 19.(169)

The heterogeneity of the population of handicapped children is illustrated by Table 12, which lists the estimated population by exceptionality. The scope of the impairments listed range from deficiencies of the sense to disabilities of psycho-motor response. Causes, severity, and manifestations

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*This section is based primarily upon a study by Rothenberg dated December, 1973. Additional supporting references may be found in the study report.(16) More recent reports not made use of include Refs. (302) and (303).

TABLE 12: ESTIMATED HANDICAPPED CHILD POPULATION, BY EXCEPTIONALITY, 1969

Exceptionality	% of 1969 Handicapped* Student Body (5-19 yrs. old)	% of 1969 Total* Student Body (5-19 yrs. old)	Estimated School-Age Population with Exceptionality	Estimated Population with Exceptionality ages 0-19
Speech Impaired	35.00%	3.500%	2,112,600	2,440,500
Hearing Impaired	5.75%	.575%	347,100	400,900
1. Deaf	.75%	.075%	45,300	52,300
2. Hard of Hearing	5.00%	.500%	301,800	348,600
Visually Impaired	1.00%	.100%	60,400	69,800
Orthopedically Handicapped and Other Health Impaired	5.00%	.500%	301,800	348,600
Multihandicapped	.60%	.060%	35,800	40,900
Mentally Retarded	23.00%	2.300%	1,388,300	1,697,500
Learning Disabled	10.00%	1.000%	603,600	697,300
Emotionally Disturbed	20.00%	2.000%	1,207,200	1,388,000

*The total handicapped student population should equal slightly more than 10% of the total student population ages 5-19.

Source: Compiled from estimates supplied by the Bureau of Education for the Handicapped for 1969, dated October, 1971.

of conditions may vary. It is difficult to get an exact reading on the handicapped student population; therefore, statistics cited should be viewed with the following limitations in mind. It is assumed that many conditions remain undetected due to the unavailability of medical care or screening procedures; more than one impairment may be present in any one individual; and gross figures fail to reflect that much is dependent upon who makes the diagnosis.

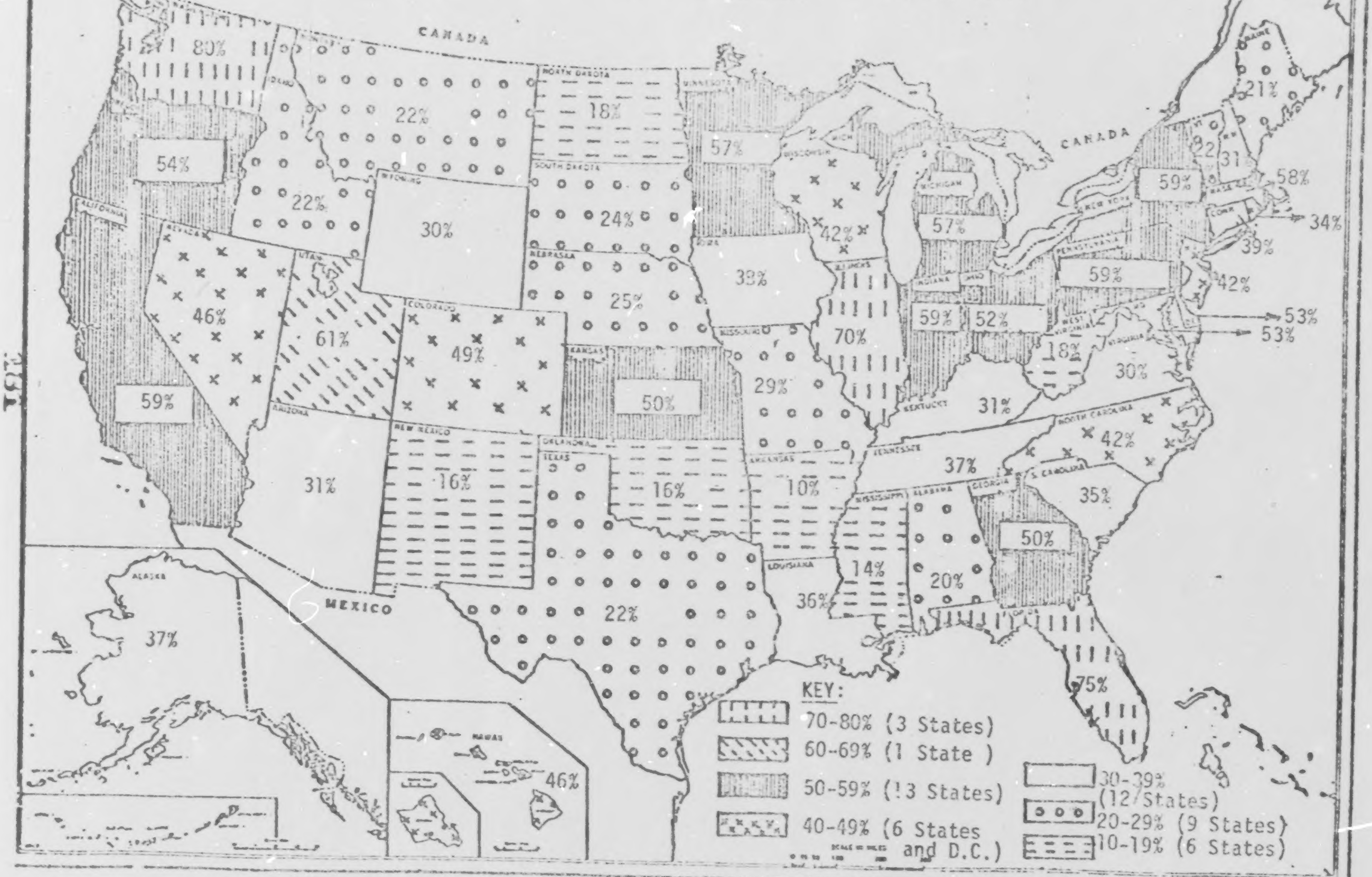
Figure 12 indicates the percentage of handicapped minors served by Special Education in each state as of October, 1971. It can be seen that many states provide services that reach only a small percentage of handicapped children. Increasing attention seems to be focussed on the need for more effort to be expended to provide educational opportunities to these individuals. Table 13 compares enrollments in special education programs in various institutions for 1970-71 with 1963 enrollments. Although some progress has been made, more remains to be done.

2. Location for Special Education

The best educational placement of the handicapped child requires careful consideration. Total separation or "segregation" from the non-handicapped peer group is not always deemed the best solution. Accordingly, there are many options for placing the handicapped student. Special education may take place in a "segregated," "partially-integrated," or "integrated" environment. The handicapped student may attend a residential or day school. The education agency may be public or private. The most recently-available evidence indicates that most placements are in public day schools. Estimates from the Office of Education dated 1970-1971 indicate a total of 176,000 handicapped students in residential

FIGURE 12: PERCENTAGE OF HANDICAPPED MINORS SERVED BY SPECIAL EDUCATION IN EACH STATE

Source: Based upon estimates supplied by the Bureau of Education for the Handicapped; estimates dated October, 1971.


CANADA
MEXICO
80%
54%
59%
22%
22%
46%
61%
30%
31%
49%
16%
18%
24%
25%
50%
57%
38%
29%
42%
70%
16%
10%
22%
36%
14%
57%
59%
52%
18%
31%
37%
20%
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75%
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42%
30%
59%
59%
21%
2
31
58%
34%
39%
42%
53%
53%
37%
46%
KEY:
70-80% (3 States)
60-69% (1 State)
50-59% (13 States)
40-49% (6 States and D.C.)
30-39% (12 States)
20-29% (9 States)
10-19% (6 States)

Table 13—Enrollment in special education programs for exceptional children: United States, February 1963 and 1970–71

Area of exceptionality[1]	1963			1970–71[2]		
	Total enrollment	Local public schools	Public and private residential schools	Total enrollment	Local public schools	Public and private residential schools
1	2	3	4	5	6	7
Total	1,682,351	1,570,370	111,981	3,158,000	3,025,000	133,000
Visually handicapped	21,531	13,962	7,569	24,000	15,000	9,000
Deaf and hard of hearing	45,594	28,551	17,043	78,000	58,000	20,000
Speech impaired	802,197	802,197	([3])	1,237,000	1,237,000	.....
Crippled and special health problems	64,842	64,842	([3])	269,000	269,000	.....
Emotionally and socially maladjusted	79,587	30,871	[4]48,716	113,000	55,000	58,000
Mentally retarded	431,890	393,237	38,653	820,000	784,000	46,000
Other handicapping conditions	22,039	22,039	([3])	126,000	126,000	.....
Gifted	214,671	214,671	([3])	481,000	481,000	.....

[1] Pupils are reported according to the major type of exceptionality for which they are receiving special education.

[2] Estimated on the basis of State reports to the Office of Education.

[3] Not included in survey of residential schools.

[4] Includes education programs in public hospitals for the mentally ill.

SOURCES: U.S. Department of Health, Education, and Welfare, Office of Education, survey of *Special Education for Exceptional Children*, and *Annual Report of the U.S. Commissioner of Education, Fiscal Year 1971*.

situations while 2,982,000 youngsters were placed in local public schools. This equals an estimated special education enrollment of 3,158,000. (See Table 13.) Instruction of those confined at home or institutions other than schools appears to be a small proportion of the handicapped.

The degree of integration with the non-handicapped may depend upon a number of factors, possibly including the availability of facilities and personnel, such as those for occupational education; opportunities for joint activities; and the mobility of the handicapped student or the adaptability of school surroundings. A segregated, or totally separated, situation would involve either the homebound or hospitalized student receiving instruction at his place of confinement, or the youngster attending a school serving only handicapped students. Partial-integration may be accomplished by either maintaining a distinct classroom for handicapped youngsters within a "regular" school, or by a student receiving appropriate instruction on a released-time basis from his regular classroom. Released-time instruction is given by an itinerant teacher serving students at different schools; teacher and students meet in a "resource room," or designated classroom, at each school. It is the general pattern that students with speech impairments or learning disabilities receive special instruction in a resource room on a released-time basis. Total integration implied no distinction between a handicapped youngster and his non-handicapped peers. It is possible that some handicapped students considered unserved by special education within the context of this memorandum are actually totally integrated into the public education system.

3. Characteristics and Infrastructure of Special Education

While serving a distinctive and diverse student body, special education retains other distinguishing characteristics. Special education is a labor-intensive service, often provided on an expanded district basis. The student-teacher ratio found in most special education classrooms, excluding those served in resource rooms, is lower than that found in most "regular" classrooms. Additionally, the handicapped child is served by a "team" of professionals: initial detection and follow-up is provided by medical professionals and paraprofessionals, psychologists, and social workers; specialized administrators for special instructional services swell the ranks of the classroom teachers in providing the educational component. Thus, often the only way a local system is able to provide such services is by combining resources with neighboring districts. Provision of special education has been the most prevalent motivation for inter-district cooperation.

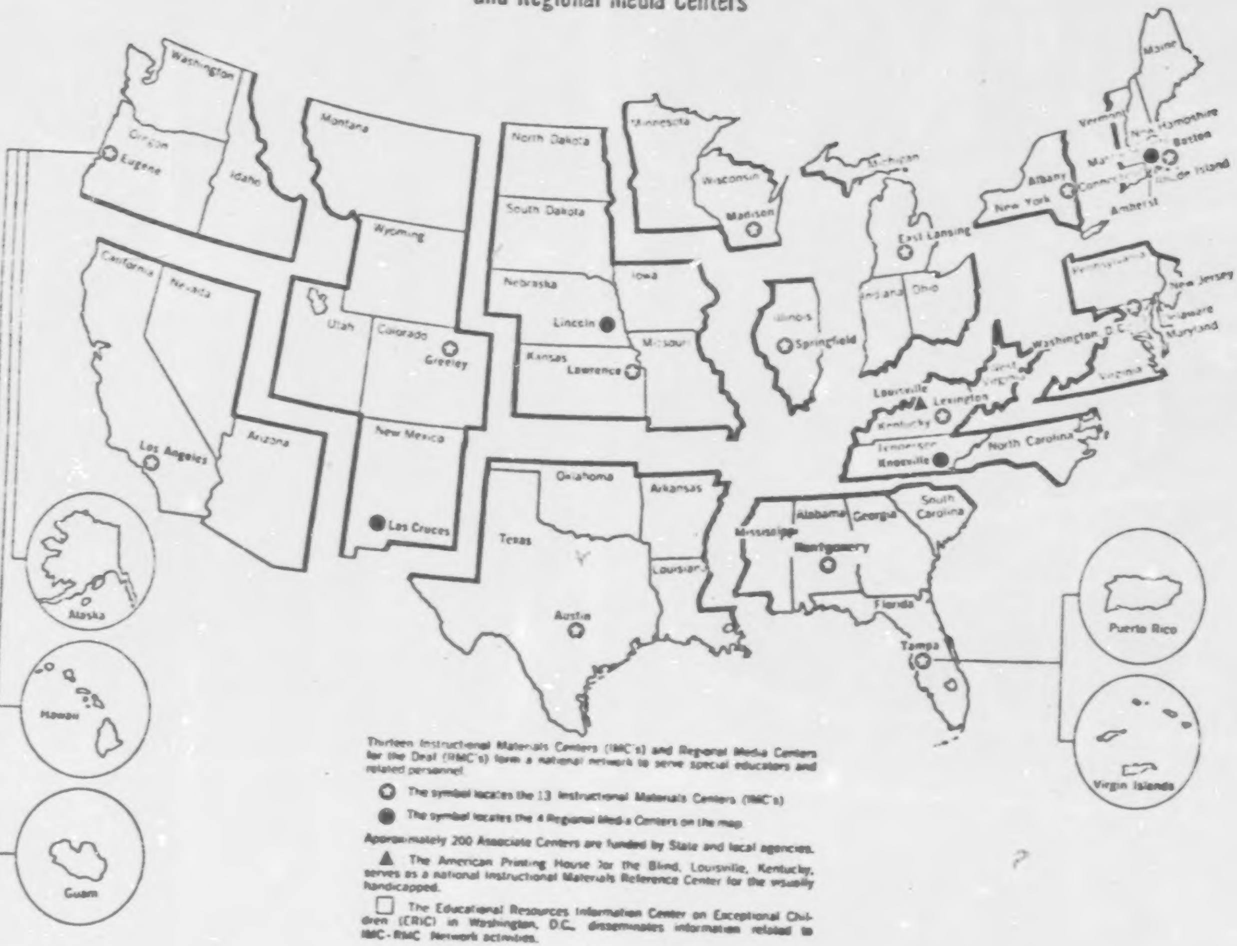
The identification of out-of-school delivery points and audiences for special education materials and services deserves attention when considering the likelihood of expanded audiences on a regional or national level. The handicapped community, their families, and the professional "team" serving them are now seemingly criss-crossed by constituent organizations and institutions. Close school-home cooperation is fostered by special educators; parental involvement in organizations dedicated to a particular handicapping condition is presumably close; service team personnel maintain their own organizations to promote continued professional development; and there undoubtedly must be some overlap among all the groups listed. Therefore, regional or national audiences may be reached through existing constructs.

An organization of interest is the National Center on Education Media and Materials for the Handicapped which dates from June 1, 1972.(170) It is at the apex of regionally-based centers which provide for the development and distribution of instructional materials for handicapped learners. (See Figure 13 .) The functioning, decentralized network now in existence includes among other outlets, Special Educational Instructional Materials Centers, Regional Media Centers for the Deaf, and 200 Associate Centers funded by state and local sources. This latticework system provides links between the classroom special educator, state-wide agencies, regionally-based resource centers, and centers for a nationally-based handicapped constituency, to facilitate information flow regarding new materials and media use for handicapped students. Distribution is currently via conventional means; however, National Center planners envision a more developed system relying upon electronic means to insure speed of feedback to the user, individualized responses, and prompt delivery of requested materials.

There could be "spin-offs" from utilizing large-scale electronic technology in the education of the handicapped which may also provide other services. The team of professional medical, educational, and social science personnel necessary to identify and treat handicapped youngsters is in short supply. It is this team which provides continuous service to the handicapped youngster. Although special education itself will probably continue to retain its labor-intensive characteristics, maximizing the coverage area of medical, paramedical, and education specialists providing evaluative, medical, and related services would appear to be of importance. The properties of swift information transfer via new technological applications, currently being developed, may be very helpful to the handicapped population. Prompt dissemination of complete medical and educational files to all designated parties, with suitable safeguards for privacy, would

FIGURE 13

Network of Instructional Materials Centers and Regional Media Centers


Washington
Oregon
Eugene
Idaho
Montana
Wyoming
California
Nevada
Utah
Colorado
Greeley
Arizona
Los Angeles
New Mexico
Las Cruces
North Dakota
South Dakota
Nebraska
Lincoln
Kansas
Lawrence
Iowa
Missouri
Minnesota
Wisconsin
Madison
Michigan
East Lansing
Illinois
Springfield
Indiana
Ohio
Oklahoma
Arkansas
Texas
Austin
Louisiana
Mississippi
Alabama
Georgia
Montgomery
South Carolina
Florida
Tampa
Louisville
Lexington
Kentucky
Tennessee
Knoxville
North Carolina
West Virginia
Virginia
Washington, D.C.
Maryland
Delaware
New Jersey
Pennsylvania
New York
Albany
Connecticut
Amherst
Rhode Island
Boston
Massachusetts
Vermont
New Hampshire
Maine
Alaska
Hawaii
Guam
Puerto Rico
Virgin Islands

Thirteen Instructional Materials Centers (IMC's) and Regional Media Centers for the Deaf (RMC's) form a national network to serve special educators and related personnel.

○ The symbol locates the 13 Instructional Materials Centers (IMC's)

● The symbol locates the 4 Regional Media Centers on the map.

Approximately 200 Associate Centers are funded by State and local agencies.

▲ The American Printing House for the Blind, Louisville, Kentucky, serves as a national Instructional Materials Reference Center for the visually handicapped.

☐ The Educational Resources Information Center on Exceptional Children (ERIC) in Washington, D.C., disseminates information related to IMC-RMC Network activities.

Source (as amended): National Advisory Committee on Handicapped Children, Second Annual Report, 1969, Better Education for Handicapped Children, Office of Education, U.S. Department of Health, Education, and Welfare, Washington, D.C.

perhaps help to assure meaningful continuity of services to the handicapped individual. Improvements in large-scale electronic communications would aid the professional personnel in this field, as in others, in keeping current with new developments so they may continually refine their service to the handicapped.

4. Uses of Technology and Telecommunications

The potential role for electronic technology in the actual instruction of handicapped students will depend upon the nature of the handicapping condition. The distinct learning units and repetitiveness afforded by programmed instruction may be of value to the educable mentally retarded. The absence of emotionality and the perseverance of CAI may be of great help to the emotionally-disturbed. Recordings for the visually impaired may not prove to be the only aid to that group; closed-circuit television systems employing special optical magnifying devices such as the one being developed by the Rand Corporation,(171) show promise of allowing many of those previously classified as legally blind to read normal print and write with ordinary pens and pencils.

Opportunities to eliminate much of the confinement surrounding multi-handicaps, orthopedic handicaps, and other health impairments will grow as interactive telecommunications becomes more prevalent in homes and societal institutions. The limited experiment conducted by the Shawnee Mission/Overland Park School District in Kansas to service homebound students primarily with interactive, two-way cable television is but a hopeful beginning.(172)

Small-scale technology, such as improved hearing aids, have been of enormous benefit to the hearing impaired. Other media have a less well established track record. Captioned films are not new, and currently there is great interest in developing captioned television. Cultivating the hearing impaired as a distinct audience with particular programming interests, and making "regular" TV fare more available through captioning, are both current approaches. Public broadcasting is active in captioned television.(173) Hearing impaired individuals who are deaf, have little residual hearing ability, or who lost their hearing at a young age, may not have acquired the requisite language base or reading ability to utilize captioned television to its fullest potential. For those older adults undergoing a hearing loss, captioned television may be very beneficial.

A demonstration conducted with computer-aided instruction for hearing-impaired students across the country was estimated to cost 60¢ per student session.(174) This figure includes telephone line communications costs. During the 1971-1972 school year, 2279 students participated; 1,071 in a Language Arts curriculum and 2,146 in a Math curriculum. The Language Arts course was designed for a daily 10-minute session for the school year. Work on the written language patterns of hearing-impaired secondary students being done in connection with this demonstration may prove helpful in "breaking the software barrier" with severely hearing-impaired users.(174)

The video telephone, currently operational in Pittsburgh and Chicago, might prove useful to severely hearing-impaired individuals. Now used on a limited scale primarily by commercial users, the full rate of $150.00 per month would be steep for residential users.(175) Therefore, at this writing, it is unlikely that visual telephony will permeate the home market, but, with its capability to display written messages, may be of use to the deaf employee should it gain wider acceptance in the commercial market.

5. Conclusions

Education for the handicapped or "special education" is a field which is likely to grow in the future in response to a clearly identifiable need which has high social priority. As of 1971, less than half the handicapped school-age population were receiving any educational services. It is also likely that technology and telecommunications will find uses in education for the handicapped in diverse ways, depending upon the handicapping condition. The medical profession tends to be a user of technology and it seems likely that this will spill over to special education, especially where the benefits to the individual turn out to be clearly evident. However, medical and medically related services often turn out to be unequitably distributed and such may be the case here.

Public broadcasting is showing considerable interest in disseminating captioned television programs for the deaf. The use of computer-aided instruction for the deaf has also been demonstrated. Development of new technologies such as closed-circuit magnified television, braille computer terminals and reliable audio to accompany CAI may prove beneficial to the blind and partially sighted. Programmed instruction and CAI may prove useful for the educable mentally retarded whereas cable television may bring educational programming and services to homebound individuals.

Funds for special education and handicapped individuals themselves, are available from public and private sources; government and charitable organizations are prominent examples. The extent to which these sources would make available the additional funding which may be necessary to purchase equipment so that technology and telecommunications would have increased usage in special education and the life style of the handicapped remains an unresolved question. Insofar as handicapped youngsters are educated in a partially integrated or integrated environment, some of the requisite hardware may already be in place in the school setting, but some may be unsuitable. Utilization will also depend upon the suitability or adaptability of existing instructional software.

It may be assumed, however, that even with the input of electronic technology, special education will, overall, still retain its labor-intensive characteristic. The handicapped population, further splintered among specific disability groups, ideally receives the services of a full professional team. Thus, if society is serious about finding ways to improve educational opportunities to the handicapped population using technology and telecommunications, it must for some situations be prepared to bear the additional costs.

I. EDUCATION FOR CULTURALLY DIVERSE GROUPS AND GEOGRAPHICALLY DISTINCT REGIONS

1. Introduction

In this section, the focus is upon needs and opportunities for educational telecommunications utilization within two broad categories, namely, education for culturally diverse groups and in geographically distinct regions. Although individuals within these two categories make up part of the educational subsectors described previously, they tend to also retain their identity within the framework to be developed in this section.

Culturally diverse groups to be considered herein include American Indians and Black Americans. These groups seek to preserve their heritage and identity through various organizations and activities while being members of the larger U.S. society. Government programs and agencies have been developed in part in response to their needs. Migrant workers follow certain cultural as well as geographic patterns and again form a distinct, identifiable group.

Several geographical regions have been singled out for particular attention in this section. These regions include Alaska, the Rocky Mountain states, Appalachia, and the Pacific region. They represent regions in which there currently is experimental educational communication satellite activity because of potential advantages which satellites may have in serving widely dispersed, remote populations.

In what follows, each of these groups or regions will be briefly described, with emphasis on characteristics and extent of technology utilization. An initial section provides an overview of rural America, rural education, and the educational telecommunications infrastructure as it affects rural populations.

2. Reaching Rural Populations

a) Educational Telecommunications Infrastructure*

In designing educational telecommunications delivery systems, it is useful to have information concerning both age and geographic population distribution. Furthermore, it is helpful to see how these distributions overlap with existing telecommunications services. Of particular importance is the extent to which rural populations are served. Satellites hold forth particular promise for delivery of educational information to dispersed rural areas and groups. Rural areas are generally costly to reach by other communications technologies. While urban areas face the complicated problem of choosing among alternative distribution systems, rural areas may face the problem of not having any systems from which to choose.

The virtue of engaging in an intensive effort to deliver educational telecommunications services to rural areas is open to question. Goldmark(176) and other proponents of communications for rural development have suggested that using electronic communications to deliver services to rural areas can make rural life more appealing and thereby reverse the outmigration to urban areas, where congestion strains the supply of natural resources and human civility. Experience in Europe indicates that the use of tax incentives for industry location can aid in halting the ~~flow of people~~ to large cities.(177)

Others, such as Peter Morrison(178) have said that movements from rural to urban areas should be organized, not curtailed. According to this view, people move to urban areas in pursuit of opportunity, and public policy should be designed to facilitate this pursuit through the provision of information about where opportunities are most prevalent, personal and family counselling to soften the cultural shock of sudden change in habitat, pre-employment interviews, transportation assistance, etc.

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*The analysis in this subsection was developed by Walkmeyer.(47)

These opinions raise questions about the desirability of retarding outmigration and about the kinds of communications services that ought to be delivered. Communications services designed to improve rural life would, in many instances, be quite different from those designed to make outmigration orderly and rational. While this debate goes on though, 1970 Census figures indicate 26.5 percent of the population (53.9 million) residing in areas classified as rural. Of this number, 10.5 million persons were reported as residing in places with populations between 1,000 and 2,500. 43.4 million rural residents reside in places of fewer than 1,000 inhabitants. In order for these data to be fully revealing, information about the spatial distancing between rural populations would be required. If several population clusters of 1,000 are within short commuting distance of each other, the prospects for consolidating services (e.g., district learning centers) are better than if each small town is completely isolated.

Even without that information, there is sufficient information to indicate that reaching rural audiences with electronic delivery systems presents special problems. While satellites make possible point-to-rural area distribution never before possible, it is the relatively short-distance transfer of those services from satellite delivery point to consumption point that raises problems.

Perrine has pointed out that in addition to the 26.5 percent of the population residing in rural areas, as classified by the Census, another 14 million people live in cities with a population between 2,500 and

10,000.(179) Another 17 million people live in "Other" places of 10,000 or more that are not classified as "Urban fringe" or "Central cities". These latter population clusters of 2,500 or more seems to be the ones Goldmark is focussing on. Problems of ground distribution are likely to be less severe due to the availability of cable TV and/or central learning points.in the communities of 2,500 or more.

As of the early 1970's, roughly one-fourth of the population of the U.S. was without access to public television services, falling outside of the coverage area of public television stations. That is approximately the same fraction of the U.S. population that is classified as rural. Although it cannot be said that rural populations and groups without access to public television match up one-for-one, it is safe to say that there is significant overlap.*

As of November 1971, 212 public television stations served an estimated 72 percent of the population.(180) It is interesting to note that that level of service to approximately 150 million people requires one station for about every 707,000 persons (150 million ÷ 212). The Corporation for Public Broadcasting (CPB) and the National Association of Educational Broadcasters (NAEB) estimated that it would require a total of 330 public television stations to reach 95 percent of the population.(181) Thus, in order to reach most of the remaining 50 million people requires the addition of one station for about every 424,000 people (50 million ÷ 118). In terms of dollars, according to a November, 1972 JCET Newsletter item, the CPB Task Force on Long Range Financing estimated $230 million to be currently invested in public broadcasting. According to their estimate, it would take an additional $334 million to broaden coverage from the then current level to 90 percent of the potential audience by building additional broadcasting stations.(182) These estimates do not take account of the potential for extending coverage by other technologies, such as cable, translator stations or satellites.

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*In what follows, we have not attempted a detailed mapping of population and communications infrastructure. Such a mapping would, in fact, be an essential part of detailed planning for a system and has been carried out in planning for regions involved in the ATS-6 HEW experiment.

The message is reasonably clear. As the percentage of the population served by telecommunications systems approaches the saturation point, it is going to become more difficult (and more expensive) to reach the remaining population. There is some indication, however, that development is continuing to take place. As of mid-1974, the number of public television stations has grown to 246. However, some of the growth may possibly be providing a second station in some areas rather than breaking new ground. Whether one educational station constitutes adequate exposure or coverage in a city with five or six commercial stations is still another issue.

The paucity of communications channels in rural areas is not limited to public television. Although different states have shortages of different media, a review of the distribution of various communications services in the United States shows certain areas of the country to be short on all of the services. By and large, the picture is most serious in the Rocky Mountain States, Alaska, Appalachia, and the Plains States (except Nebraska).*

A check of sparsely populated states in Table 14 against figures showing distribution of educational radio stations, educational television stations, intra- and interstate television networks, ITFS systems, and projected CATV systems (Figures 14, 15, 16, 17, and 18) shows a strong correlation

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*Nebraska, a state of 1 1/2 million residents, stands in sharp contrast to the other Plains States where ETV is concerned. With 9 public television stations, 8 of them under control of the state ETV commission, Nebraska is well served. The Great Plains National Instructional Television Library (GPNITL) is located at the University of Nebraska. The SUN Open University Project is headquartered there.

TABLE 14

From: The 1972 Word Almanac and Book of Facts
Newspaper Enterprise Association, Inc. New York

States in Order of Population Density

People per sq. mile	State	People per sq. mile	State
0.5	Alaska	79.0	Georgia
3.4	Wyoming	81.1	Louisiana
4.4	Nevada	81.1	Wisconsin
4.8	Montana	81.2	Kentucky
8.4	New Mexico	81.7	New Hampshire
8.6	Idaho	85.7	South Carolina
8.8	South Dakota	95.0	Tennesee
8.9	North Dakota	104.1	North Carolina
12.9	Utah	116.9	Virginia
15.6	Arizona	119.8	Hawaii
19.4	Nebraska	125.5	Florida
21.3	Colorado	127.6	California
21.7	Oregon	143.9	Indiana
27.5	Kansas	156.2	Michigan
32.1	Maine	199.4	Illinois
37.0	Arkansas	260.0	Ohio
37.2	Oklahoma	262.3	Pennsylvania
42.7	Texas	276.5	Delaware
46.9	Mississippi	380.3	New York
48.0	Minnesota	396.6	Maryland
48.0	Vermont	623.7	Connecticut
50.5	Iowa	727.0	Massachusetts
51.2	Washington	905.4	Rhode Island
67.8	Missouri	953.1	New Jersey
67.9	Alabama	12,401.8	District of Columbia
72.5	West Virginia		

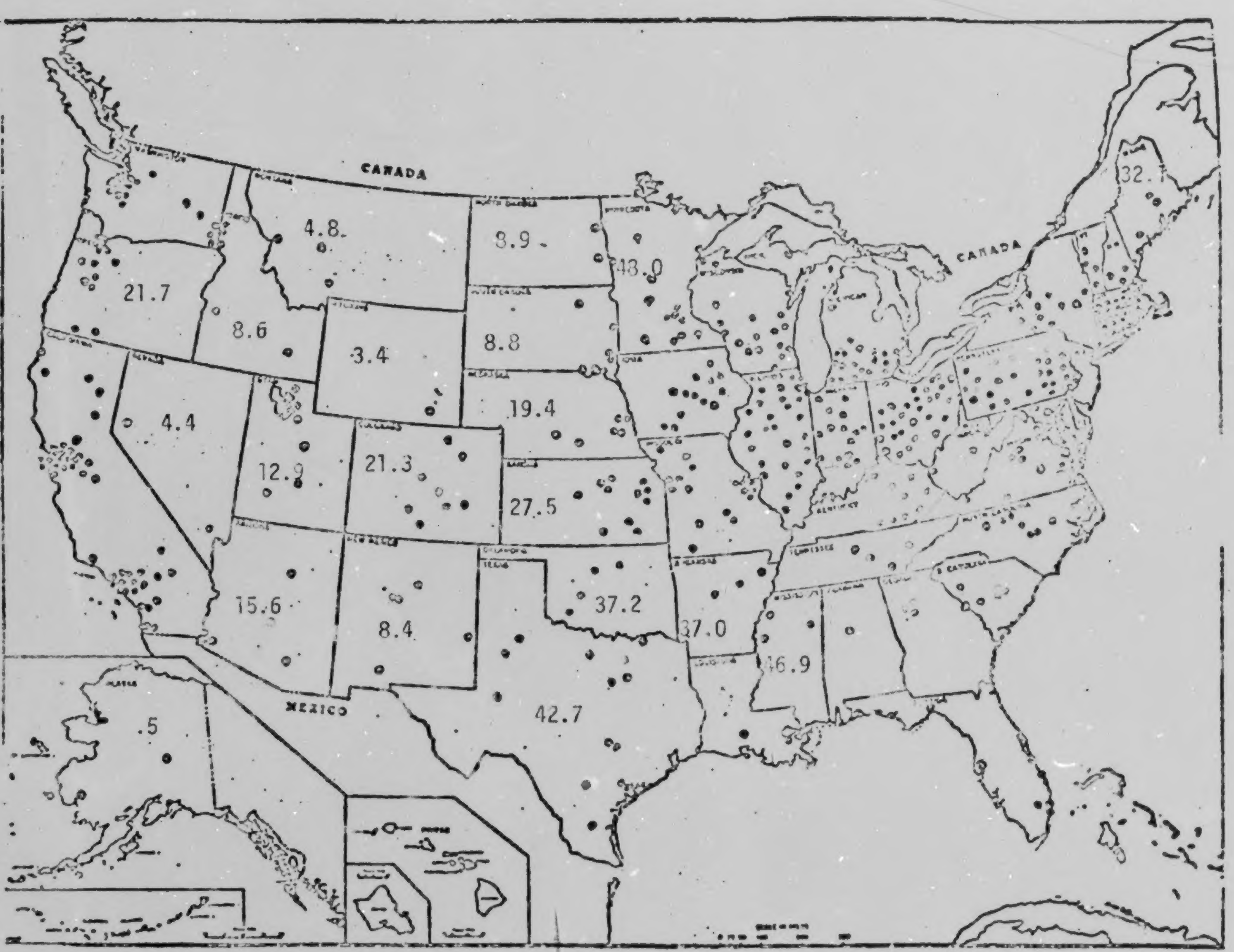
CANADA
CANADA
MEXICO
21.7
4.8
8.9
43.0
32.
8.6
3.4
8.8
4.4
19.4
12.9
21.3
27.5
15.6
8.4
37.2
37.0
46.9
42.7
.5

FIGURE 14
DISTRIBUTION OF EDUCATIONAL RADIO STATIONS AND POPULATION DENSITIES OF STATES [Ref. #7] (1971)

* States with densities indicated on the map are the 20 least densely populated.

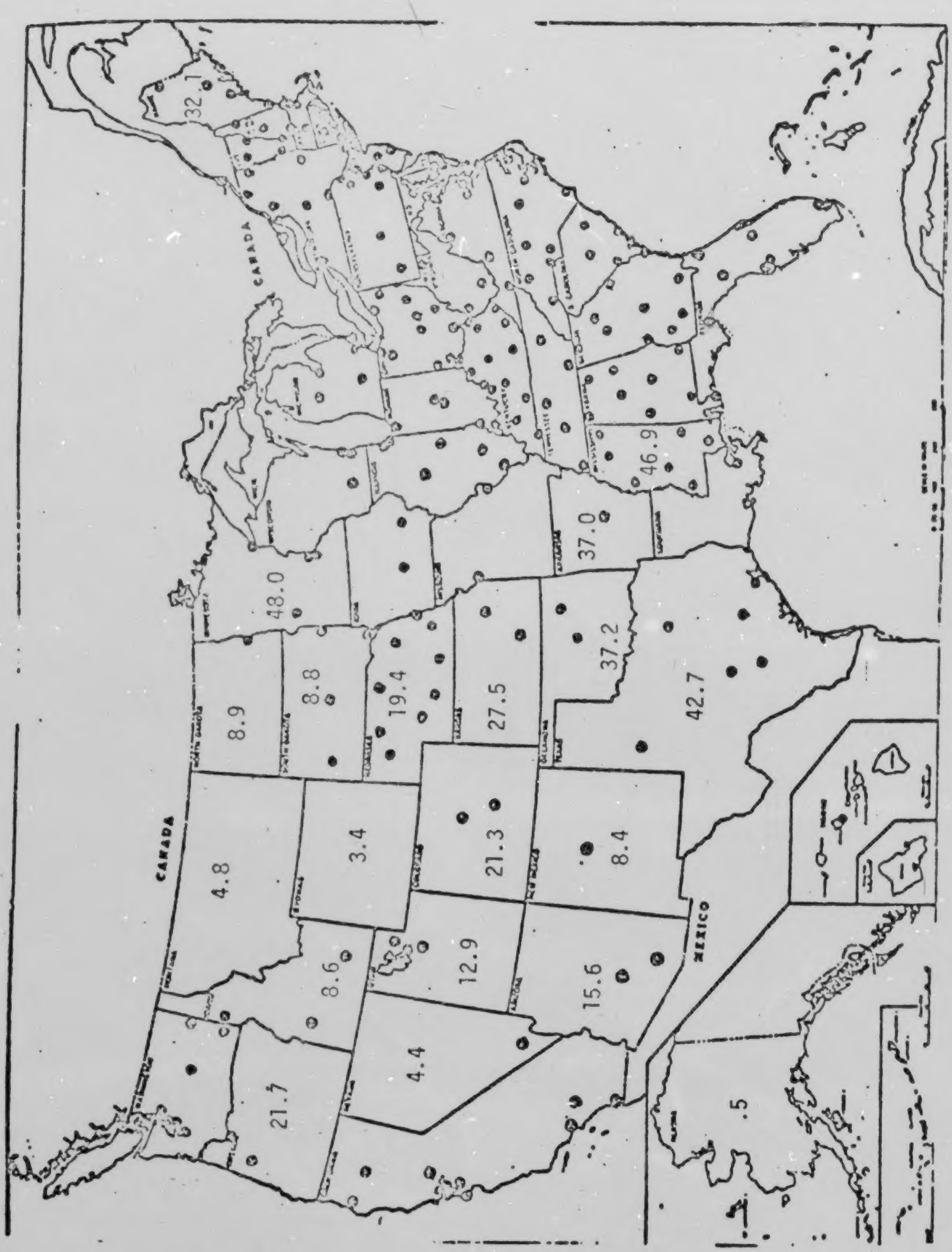
CANADA
CANADA
MEXICO
32.1
48.0
8.9
8.8
19.4
27.5
37.2
42.7
37.0
46.9
4.8
3.4
21.3
8.4
8.6
12.9
15.6
4.4
21.7
.5

FIGURE 15
DISTRIBUTION OF EDUCATIONAL TELEVISION STATIONS AND DENSITIES OF STATES [Ref. 47] (1971)

* States with densities indicated on the map are the 20 least densely populated.

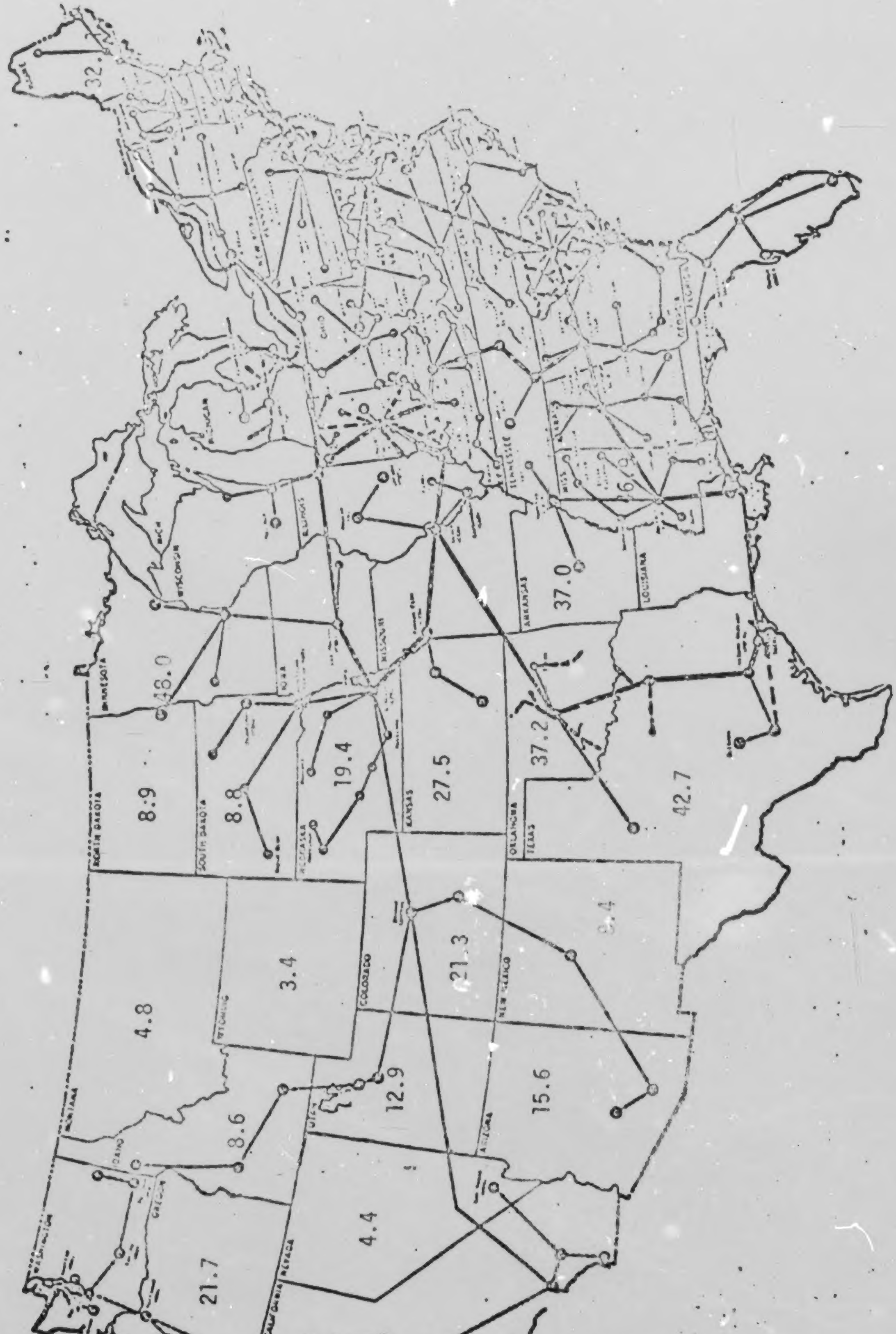
MAINE
32.
MINNESOTA
48.0
WISCONSIN
MICHIGAN
ILLINOIS
IOWA
MISSOURI
NORTH DAKOTA
8.9
SOUTH DAKOTA
8.8
NEBRASKA
19.4
KANSAS
27.5
OKLAHOMA
37.2
ARKANSAS
37.0
LOUISIANA
TEXAS
42.7
TENNESSEE
36.9
MONTANA
4.8
WYOMING
3.4
COLORADO
21.3
NEW MEXICO
9.4
IDAHO
8.6
UTAH
12.9
ARIZONA
15.6
NEVADA
4.4
WASHINGTON
OREGON
21.7
CALIFORNIA

FIGURE 16
INTERSTATE AND INTRASTATE EDUCATIONAL COMMUNICATION NETWORKS AND POPULATION DENSITIES OF STATES [Ref. 47] (1971)

* States with densities indicated on the map are the 20 least densely populated.

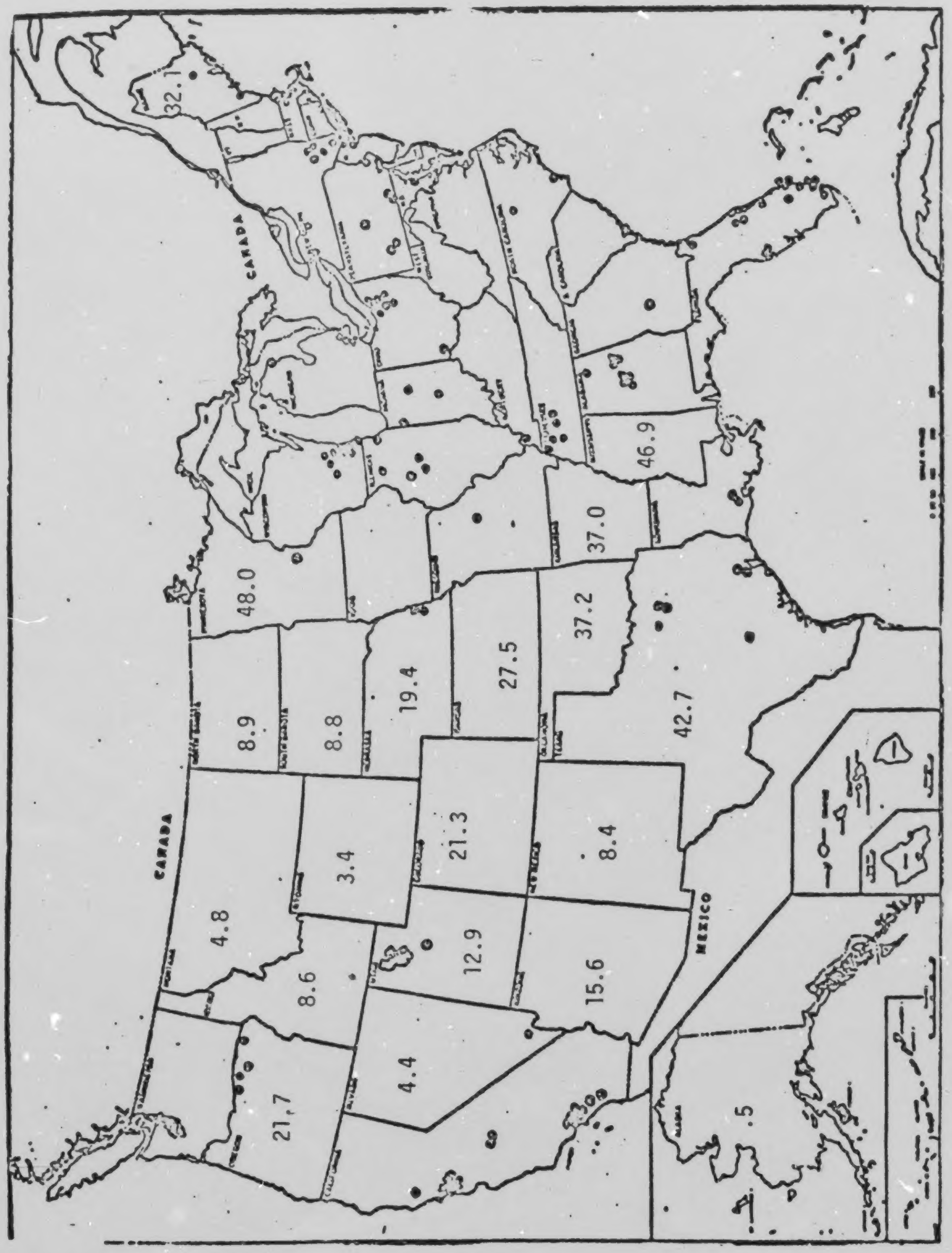
CANADA
CANADA
CANADA
MEXICO
32.1
48.0
46.9
37.0
37.2
27.5
19.4
8.9
8.8
42.7
21.3
8.4
3.4
4.8
8.6
12.9
15.6
4.4
21.7
.5

FIGURE 17
DISTRIBUTION OF ITFS INSTALLATIONS AND POPULATION
DENSITIES OF STATES [Ref. 47] (1971)

* States with densities indicated on the map are the 20 least densely populated.

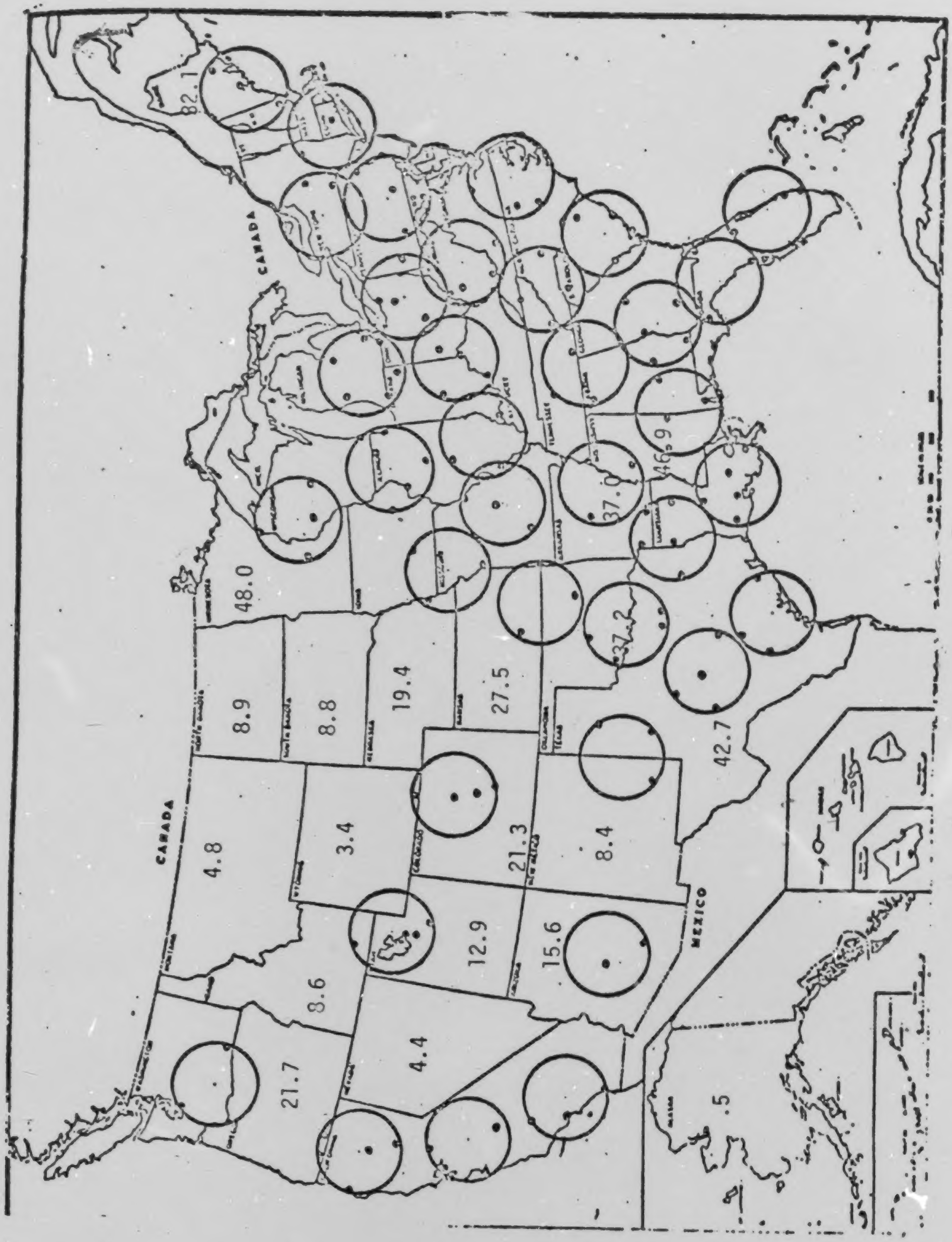
CANADA
CANADA
MEXICO
82.1
48.0
8.9
8.8
19.4
27.5
42.7
37.2
37.0
46.9
4.8
3.4
21.3
8.4
8.6
12.9
15.6
21.7
4.4
.5

FIGURE 18
PROJECTED CATV SERVICE AREAS IN 1975 AND POPULATION DENSITIES OF STATES [Ref. 47]

* States with densities indicated on the map are the 20 least densely populated.

between population sparseness and lack of communications service. The Figures are of somewhat limited usefulness because urban centers in sparsely populated states may have some educational communications services. More detailed analyses are required in planning for regional implementation to find the most economical way to deliver telecommunications-based educational services to rural areas. However, it seems evident that equalizing access in rural areas will require more investment per learner and that some degree of subsidization will be required.

b) Characteristics of Rural Education

Educational attainment in rural areas tends to be significantly lower than in urban areas (see Table 15). Almost 20 percent of rural residents aged 25 and over in 1970 did not complete the 8th Grade. Only 44.2 percent graduated from high school and half a million had no schooling at all.(183)

Perrine has indicated that schools in rural areas tend to serve relatively small numbers of students and that expenditures may tend to be lower than in urban areas due to a smaller tax base, more poverty and a higher dependency ratio.(179) Geographic isolation is a problem for both students and teachers. There is less tendency for teachers to wish to serve in rural areas, less access for rural students to sources of information and diversity of course offerings, and rising costs due to such factors as the increase in the price of gasoline for school buses. Some areas in the west have student densities below one student per square mile.

Table 16 lists the number of public school systems and number of pupils enrolled, by size of system in the U.S. in 1971-1972. The total number of school systems represents a marked decline from over 100,000 systems in the 1930's and early 1940's. Of the more than 17,000 school

TABLE 15.—Educational Attainment for Persons 25 or Over Expressed in Years of Schooling Completed for U.S., Urban and Rural Areas, 1970

Years Schooling Completed (Cumulative)	U.S.		URBAN		RURAL	
	Number	%	Number	%	Number	%
TOTAL	109,890,962	100	81,147,679	100	28,743,382	100
None	1,748,415	1.5	1,251,144	1.5	497,268	1.7
Less than 5	6,054,526	5.5	4,035,342	4.9	2,019,184	7.0
Less than 8	17,185,573	15.6	11,559,413	14.2	5,626,160	19.5
Less than 12	52,564,464	47.8	36,518,084	45.0	16,046,380	55.8

SOURCE: 1970 Census, Subject Report; Educational Attainment. Pages 30 and 32.

TABLE 16.—Number of public school systems and number of pupils enrolled, by size of system: United States, 1971-72

	School systems		Pupils enrolled	
	Number	Percent	Number (in thousands	Percent
1	2	3	4	5
TOTAL	17,238	100.0	248,010	100.0
25,000 or more	194	1.1	14,084	29.3
12,000 to 24,999 . . .	423	2.5	6,938	14.5
6,000 to 11,999	990	5.7	8,194	17.1
3,000 to 5,999	1,913	11.1	7,966	16.6
1,800 to 2,999	1,952	11.3	4,541	9.5
1,200 to 1,799	1,650	9.6	2,446	5.1
600 to 1,199	2,635	15.3	2,268	4.7
300 to 599	2,367	13.7	1,037	2.2
150 to 299	1,645	9.5	366	.8
50 to 149	1,416	8.2	136	.3
15 to 49	905	5.3	26	.1
1 to 14	770	4.5	7	(4)
None	378	2.2	0	0

[1] Based on the number of pupils enrolled in October 1971.

[2] Includes 1,832,000 students enrolled at the college level.

[3] Systems not operating schools.

[4] Less than .05 percent.

NOTE:—Because of rounding, detail may not add to totals.

SOURCE.—U.S. Department of Commerce, Bureau of the Census, 1972 Census of Governments, Vol. 1, Governmental Organization.

systems, Perrine estimates that more than 13,000 are rural, and serve much smaller numbers of students than in urban areas.(179) These districts might be interested in the possibility of sharing instructional resources not currently available to these districts via telecommunications, although the issue of local control will clearly be evident.

Several of the groups to be described subsequently share in the problems of rural America. However, some may also have a strong urban identification as well. The initial emphasis on the rural setting in this section is consonant with the ability of satellites to aggregate masses of users of information over widespread areas.

3. Migrant Workers*

a) Introduction

There are probably between 500,000 and 1,000,000 people migrating and working in farm jobs in the United States, although an exact figure is impossible to determine. The most quoted figure of the total is that used by the Economic Research Service of the U.S. Dept. of Agriculture, which estimated that in 1969, there were 257,000 workers over 14 years of age not including children or non-working dependents. The U.S. Office of Education states that 220,000 migrant children between the ages of 5 and 17 are participating in their programs.

Migrants move not only with the sun, but also in patterns that have led to the delineation of the movements into "streams". (See Figure 19.) The "source" or starting point of these streams is basically the southernmost states of California, Texas and Florida. The Eastern Stream migrants move basically along the coastal states of the east, the other coast for the Western Stream and the Central area is covered, in large part, by the

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*The material in this section is based upon a study by Perrine. For additional documentation and references, see the complete study report. (179)

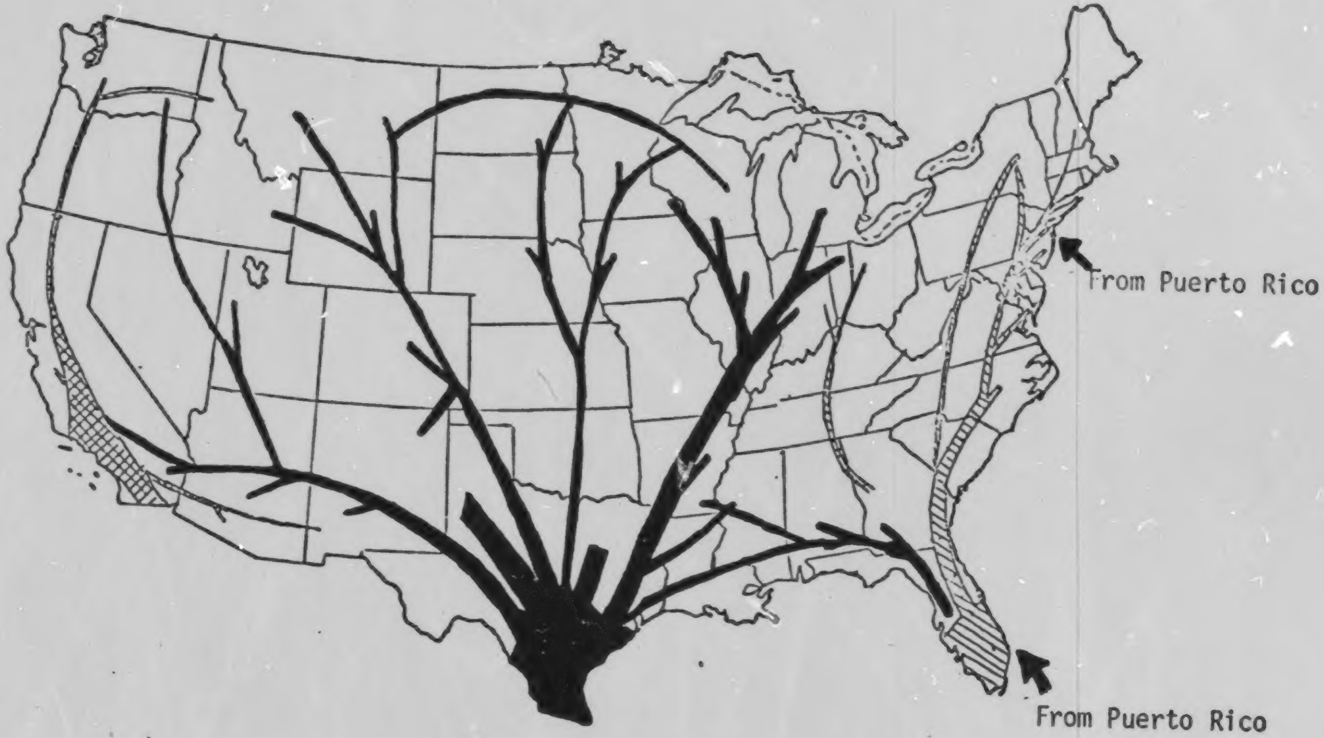
From Puerto Rico
From Puerto Rico

Figure 19

TRAVEL PATTERNS OF SEASONAL MIGRATORY AGRICULTURAL WORKERS* stream from Texas. A Social Security bulletin uses the figure of 500,000 total migrants and assumes 350,000 to 400,000 workers.(184) The same bulletin breaks the total down into "streams" of 250,000 for the Texas stream, 100,000 for the Western/Pacific stream, and 100,000 for the Eastern stream. (See Figure 19.) Figures 20 - 23 show the geographic distribution of migrants with the seasons.

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*Source: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Publication No. 540, 1966.

Surplus labor, or labor that is abundant at or below subsistence wages, is becoming difficult to obtain in the U.S. even for agricultural purposes. In the recent past, labor has been imported specifically for agricultural employment, mostly from Mexico. Due to immigration laws, and laws specially directed towards farm labor such as the termination of the Bracero program,* there has been a drastic cut in the number of foreigners working on American farms. As long as the economy is basically stable, industrial and service sectors can generally "absorb" labor from the agricultural sector. If the pull toward industrial jobs becomes too great the agricultural sector is forced to offer higher wages, better working conditions and other amenities offered in the industrial sector. In fact we are witnessing the social reactions to this economic shift. Unionization of farm workers is occurring under the leadership of Cesar Chavez, a Mexican-American working with many farm workers who came to the U.S. under the Bracero program. Farmers are finding that higher wages and better working conditions are necessary to attract workers, but many are turning instead to mechanization. As migrants move up the social ladder to either a union farm worker or a wage earner in industry, they need more preparation for these new ways of life--education is one technique.

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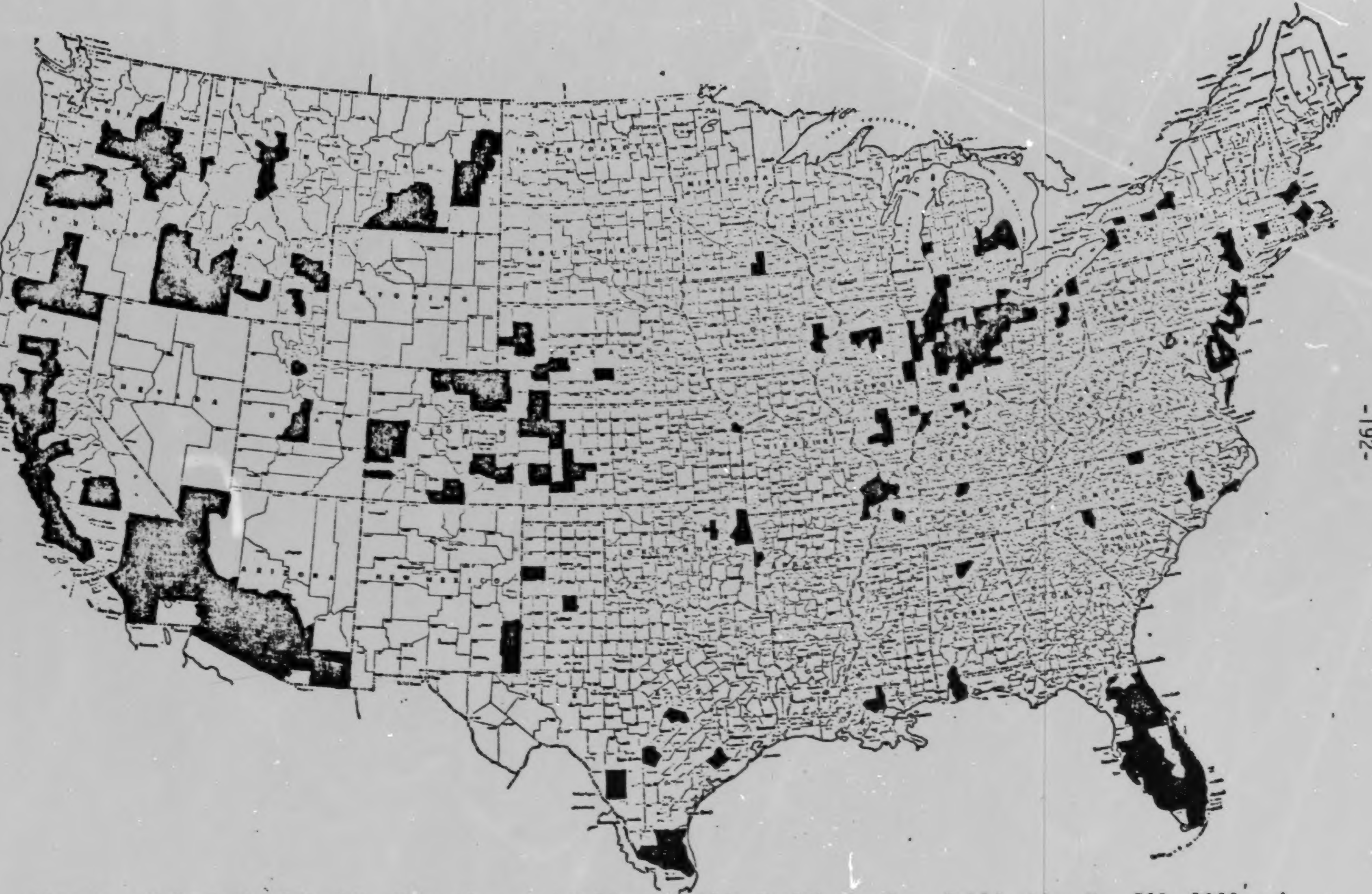
*Public Law 78 which expired Dec. 31, 1964 permitted foreigners to enter the U.S. for farm work. Special cause must now be shown to import labor for agriculture.

FIG. 20*: SEASONAL MAP SHOWING COUNTIES WITH OVER 100 MIGRATORY FARM WORKERS

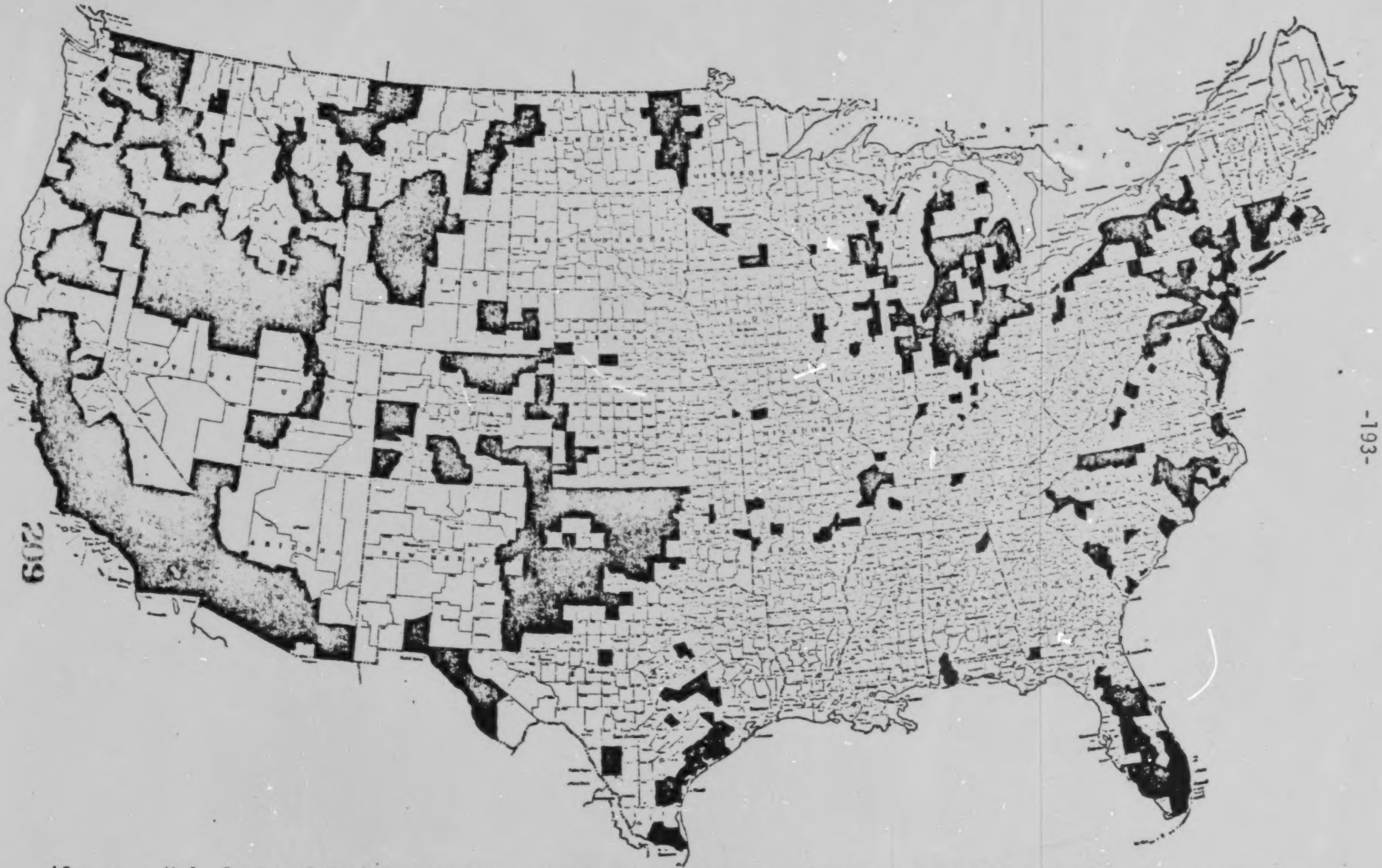
Season: Spring



*Source: U.S. Dept of Health, Education, and Welfare, Public Health Service, Publication No. 540, 1966 and U.S. Dept of Labor, Farm Labor Service, 1966. (Developed by Perrine (179))

FIG. 21*: SEASONAL MAP SHOWING COUNTIES WITH OVER 100 MIGRATORY FARM WORKERS

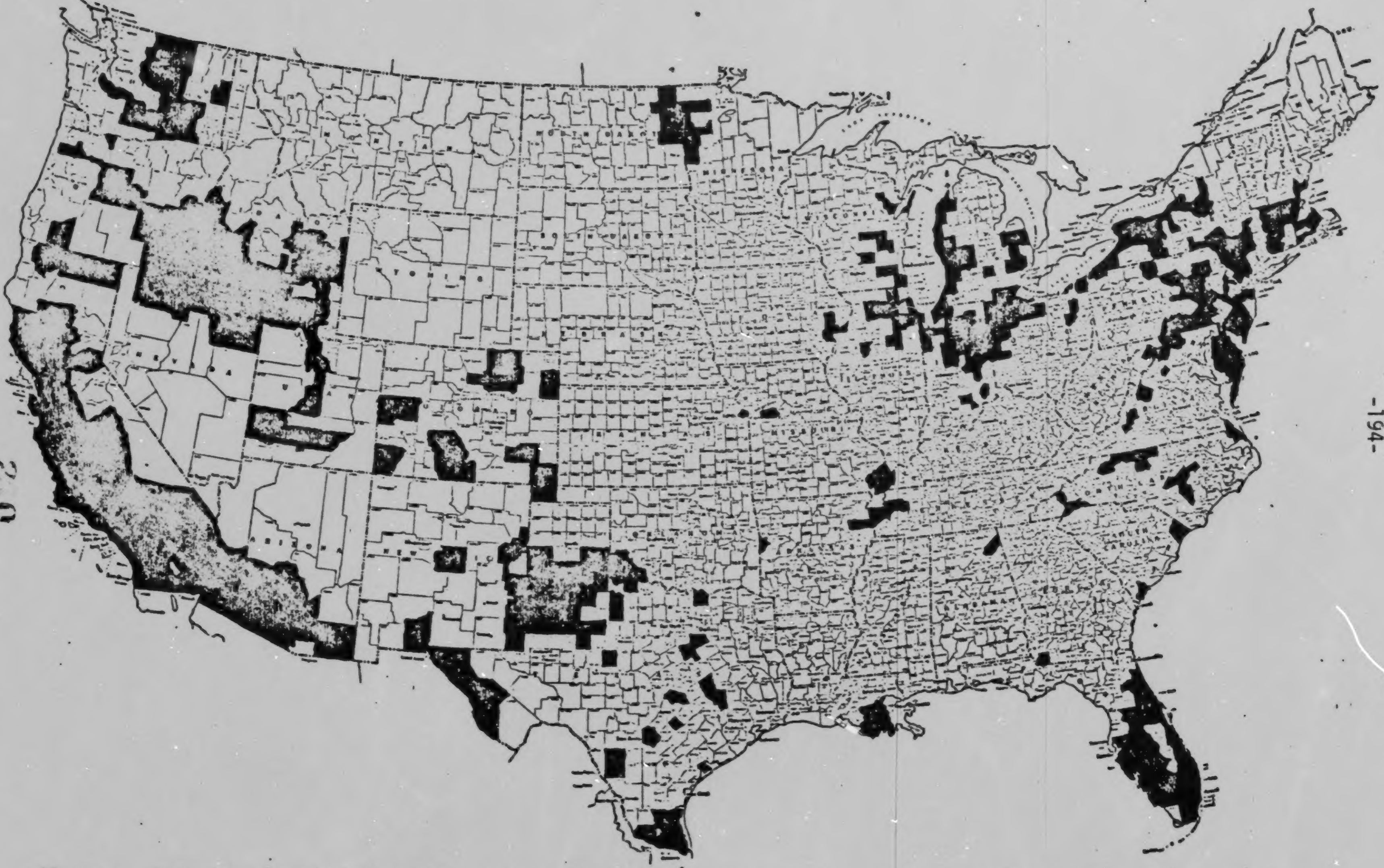
Season: Summer



*Source: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Publication No. 540, 1966 and U.S. Dept. of Labor, Farm Labor Service, 1966. (Developed by Perrine (179))

FIG. 22*: SEASONAL MAP SHOWING COUNTIES WITH OVER 100 MIGRATORY FARM WORKERS

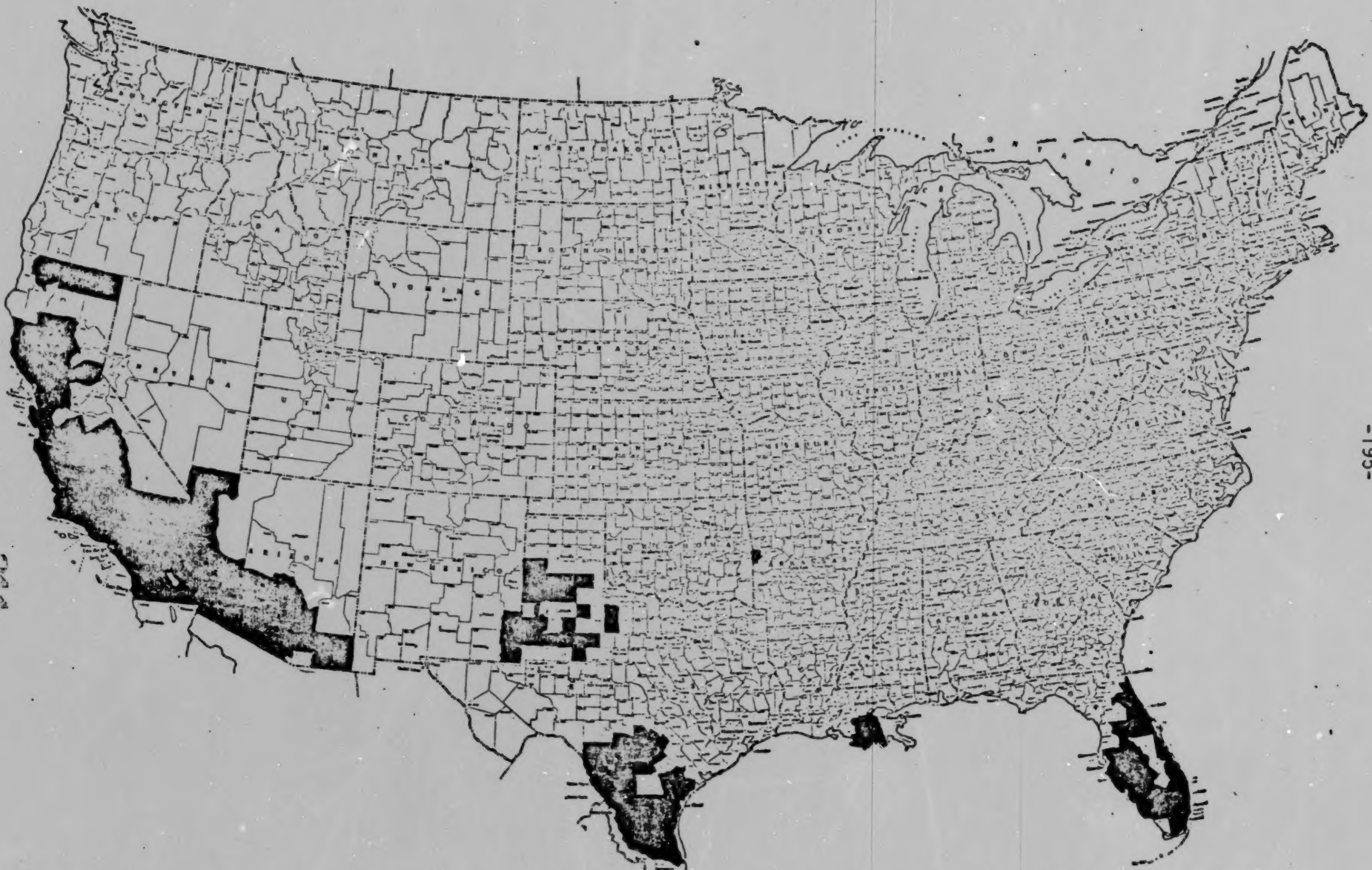
Season: Fall



*Source: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Publication No. 540, 1966 and U.S. Dept of Labor, Farm Labor Service, 1966. (Developed by Perrine (179))

FIG. 23*: SEASONAL MAP SHOWING COUNTIES WITH OVER 100 MIGRATORY FARM WORKERS

Season: Winter



*Source: U.S. Dept. of Heath, Education, and Welfare, Public Health Service, Publication No. 540, 1966 and U.S. Dept of Labor, Farm Labor Service, 1966. (Developed by Perrine (179))

There is no doubt that jobs for migrants are decreasing. A 20% drop in labor demands was predicted by 1976 in Washington state.(185) In Michigan, the employment of interstate workers fell from 56,000 in 1969 to 48,000 in 1970 or a decrease of 13 percent, and the intrastate workforce dropped from 10,500 persons in 1969 to 8,000 in 1970 or a 24% decline.(186) In New Jersey:

> "Major reductions in harvest labor demands are expected to occur during the first half of the 1970's and a further reduction of approximately 5,000 workers is expected to occur by 1975. By 1980, it is forecast that there will be fewer than 10,000 seasonal farm workers required at the peak of the summer season." This is in comparison to 25,000 workers during the peak of the season in 1965. (187)

A report from Texas products the total percentage of all vegetables machine harvested to increase from 56% to 75% by 1975,(188) indicating that as food production increases through technological means, migrant jobs decrease.

Many ethnic and cultural groups can be found in the fields; they include: Chicanos, Blacks, Whites, Indians, Puerto Ricans, Islanders (Virgin Islands and West Indies), and others including Canadians and Orientals. Some migrants move in groups of unrelated people, some in families and some alone. Sixty-five percent of groups surveyed by the Good Neighbor Commission of Texas were composed of 10 people or less, of which 40% were children and 60% adults evenly distributed between sexes.(188) The average migrant worked a total of 118 days in 1971 and earned $1,630; many worked and earned less.(189) "The typical adult migrant has completed the eighth grade," and the life expectancy of the average migrant is 55 compared to the age of 70 for an average American.(185) One study found 58% illiteracy(188) and another study found an average IQ rating to be 15% less than the normal for the same age groups.(190) According to a U.S. Department of Health, Education and Welfare publication, 90% of all migrant children never finish high school and their average education level is fourth or fifth grade.(191)

b) Migrant Education; Telecommunications Projects

The constant moving from location to location, from state to state and from one place to another within states has led to very piecemeal education patterns. In addition to the sporadic discontinuous nature there are language, cultural problems, and racial fears that are not well handled by the present educational delivery system. There is little parental or group pressure to succeed in educational attainment for later economic gain.

> "Fatigued parents do not have the time, energy, and emotional resources that are needed for giving to their children the physical care, the guidance, the instruction, and the emotional warmth which young children so desperately need. Possessing of but limited educational attainments themselves, the parents have not been able--and are not now able--to provide their children with patterns of day-to-day and hour-to-hour behavior which the children may internalize and which, once possessed by the children, will help them to meet the expectations of those people upon whom their later advancement will depend." (192)

Migrants are regarded by many as the "disadvantaged of the disadvantaged." Basically migrants seem to be deficient in comprehension of material taught in courses or subjects normally offered in school. In addition, special problems of language, interpersonal relations, motivation and self concepts are commonly found.

Migrant adults, parents and students all express interests in practical skills and abilities when surveyed on their needs and hopes. Many are interested in better paying agriculture-related occupations other than picking and weeding. 60% of recently settled migrants were still working in agriculture.(185) Migrants are looking for incremental change, not drastic revision in life style.

Unless there are drastic changes in the economic sector or major new revisions of the immigration laws, it appears that the time is here to prepare migrants to enter the "mainstream" of society in America. As an indication, the Department of Labor has a program to help migrants, and provide encouragement, in "settling out", as they call it, from the migrant stream. "The Last Yellow Bus" program initiated under the Rural Manpower Service in 1971 received a 20 million dollar funding level for 1972.(193)

Development of more migrant education programs has been on the upswing since the Federal Government began awarding grants through PL 89-10, Title 1, in the early sixties. Individual states have implemented programs to avail themselves of this funding. Forty-five states received Title 1 funds in 1970 totaling over $50 million.(194)

Some programs sponsored by states have incorporated audiovisual and telecommunications technology to facilitate learning, and to improve language and social skills. These projects are usually sponsored by state departments of education with federal funds. An exception was "The Camera as Eye of the Mind" project which was sponsored by the Teacher Corps with help from Eastman Kodak. Some projects which have been undertaken include:

> "The Camera as Eye of the Mind" project in California where children photograph what they think about and subsequently learn to write stories about their photos in English, and thus make simultaneous adjustment while learning a new language and culture.
>
> FM Radio project in Florida where radio broadcasts are used to encourage children to attend school, encourage adults to attend adult education and to allow migrants the opportunity to program and participate in the proeduction of media for radio--a "power to the people" project.

TV language program in New Mexico area which broadcasts language courses over the area for Chicanos (including migrants) to learn English through lessons and drama presentation.

Pilot V Video project in New Jersey. A very thorough program using experienced migrant teachers, script writers and consultants to develop and write a series of video tapes for migrant children. Included in the program are tapes to teach migrant teachers, and opportunities for peer group video tape production opportunities.

One of the strong points of the above projects has been the attention and importance given to assessing specific educational needs and then utilizing the best available talent to produce programs that still permit flexibility in the classroom but are more systematic than the randomness of individual teachers.

Administrators and teachers of migrant educational projects have been meeting on a regional and nationwide basis to exchange ideas on curriculum, programs and coordination of programs between states. One concrete example of their efforts is the Migrant Student Record Transfer System, a computer system used to electronically transfer school records and health records of migrants.* Some potential migrant-oriented uses for large-scale educational telecommunications systems include:

1. record transfers (school and health)
2. work orders, job requests, job applications
3. video tape programs, live programs, audio programs for migrant school children to provide a continuity and backbone for migrant children as they move from place to place

---

*The Migrant Student Record Transfer System received funding of 1.8 million in FY 73. At that time, there were 400,854 students records already in the system serving 7,000 schools. The system is expecting to expand. (195)

4. Programs to teach migrant teachers
5. Language training (children and adults)
6. Adult education (basic and vocational)
7. Health education (children and adults)
8. "Settling out" information.

Assuming a nationwide network were to be established or was in existence that reached areas where migrants are to be found, the following subjects could be aided using an educational telecommunications system:

A. Adult vocational training
B. Communication through audio and visual media (i.e., radio and television)
C. Communication of migrant problems, programs and progresses to wider world (as through television broadcast).

Discussions with personnel in the field by Perrine(179) indicate that funding in the future is going to be a serious problem for migrant education projects with the shift to revenue sharing program. If state education departments can work together as they did for the computerized record transfer system, and for discussing problems and sharing curricula, perhaps they could jointly develop a more comprehensive migrant education system, utilizing telecommunications networks. An educational package offering nationwide delivery, if well conceived, comprehensive and detailed, might appeal to the federal government for funding if it were relatively inexpensive and if the system seemed to offer the educational aspects presently lacking. Technology could be used to "keep up" with, or better follow, the routes of presently undereducated migrants, especially children. Here is a prime example of a situation in which the technology seems appropriate, provided organizational and political issues related to education which transcend state boundaries can be coped with.

3. Native (Indian) Americans[*]

a) Introduction

To be an American Indian in this decade is to be one of 794,730 individuals (1970 Census)[**] who traditionally represent approximately 140 tribes living on 115 reservations; vestiges of great Indian nations surface upon realization that fully 1/3 of this number are either Sioux, Chippewa, Cherokee, or Navajo. (See Figure 24 for location of tribes.) To be a contemporary American Indian is also to be part of a population that is predominantly young (20.4 years median age), unemployed (only 24.9% employed), living off the reservation (580,960), and poor ($1575 average per capita income; $2108 if a city dweller versus $1147 if a country sider). Finally, to be an American Indian today is to belong to a group that has performed poorly when compared to educational norms established by and for the mainstream society; concentrating on attendance only, 1/3 of all Indians complete high school, less than 1% graduate from college, while the median level of schooling for adults over 25 approaches 10th grade.(196, 197) A sign of change is a new emphasis upon formal education by natives themselves.

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[*] The material in this section is based upon a study by Perrine. For additional documentation and references, see the complete study report.(179)

[**] Perrine extrapolates a 1974 Indian population of 900,000 based upon a 3.3% annual growth rate. He further projects 1,000,000 by 1976. (179)

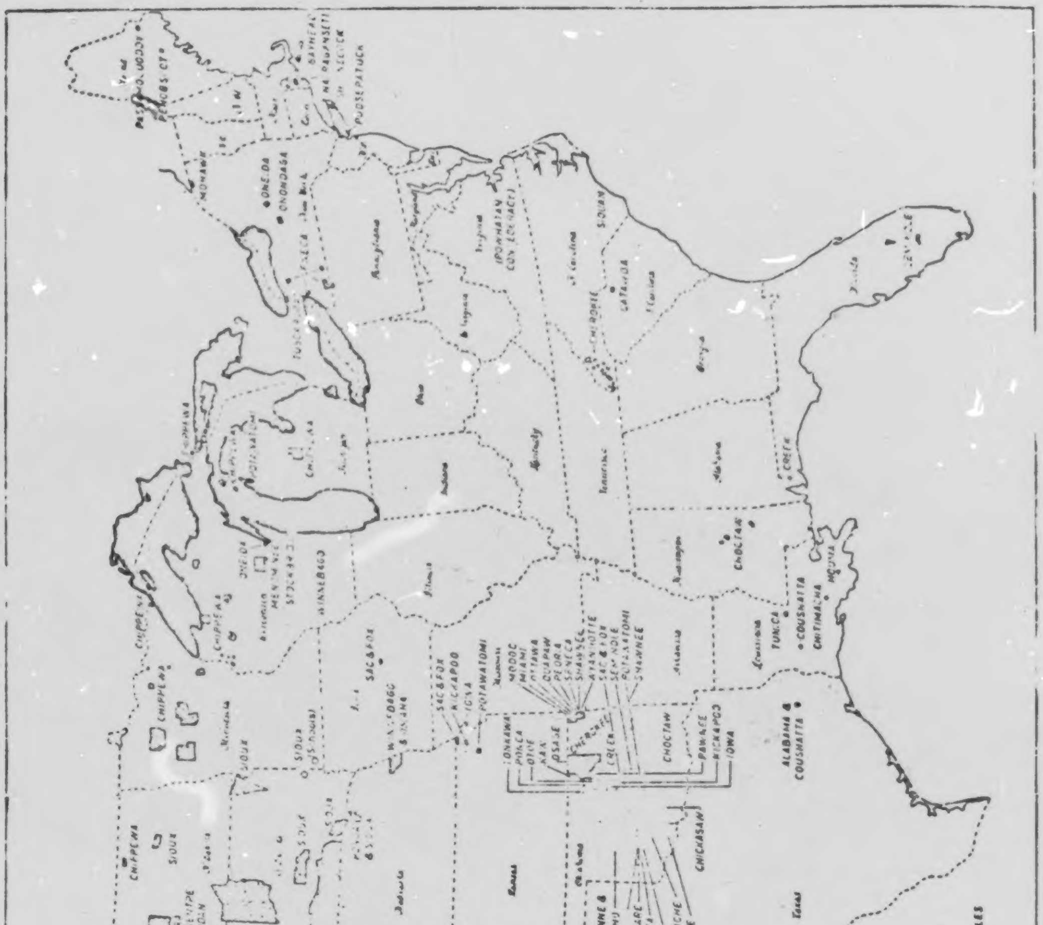
RESERVATIONS AND TRIBAL LANDS
COLONIES IN NEVADA
RANCHERIAS IN CALIFORNIA
0 100 200 300 400 MILES
ESKIMO
ATHABASCAN
TLINGIT
HAIDA
TSIMSHIAN
ALEUT
CALEPOOYA
CLACKAMAS
KLAMATH
ROGUE RIVER
TUTUNI
UMPQUAH
CHASTA COSTA
SUQUAMISH
COLVILLE & SPOKANE
COEUR D'ALENE
YAKIMA
KOOTENAI
KALISPEL
NEZ PERCE
UMATILLA
CAYUSE
WALLA WALLA
PAIUTE
KLAMATH
MODOC
PIT RIVER
HOOPA & YUROK
PAIUTE & WASHO
PAIUTE & SHOSHONE
SHOSHONE
SHOSHONE & BANNOCK
GOSHUTE
UTE
BLACKFEET
SALISH & KOOTENAI
CHIPPEWA & CREE
GROS VENTRE & ASSINIBOIN
SIOUX & ASSINIBOIN
CHEYENNE & CROW
ARAPAHO & SHOSHONE
HUALAPAI
YAVAPAI
MOJAVE
CHEMEHUEVI
MISSION
YUMA
COCOPAH
PAPAGO
PIMA & MARICOPA
APACHE
NAVAJO
PUEBLO
ARIKARA GROS VENTRE & MANDAN
CHIPPEWA
SIOUX
CHEYENNE & ARAPAHO
CADDO
DELAWARE
WICHITA
KIOWA
COMANCHE
CHICKASAW
CHOCTAW
PAWNEE
KICKAPOO
IOWA
TONKAWA
PONCA
OTOE
KAW
OSAGE
CREEK
SEMINOLE
SHAWNEE
POTAWATOMI
MODOC
MIAMI
OTTAWA
QUAPAW
PEORIA
SENECA
WYANDOTTE
SAC & FOX
WINNEBAGO
ONEIDA
MENOMINEE
STOCKBRIDGE
ALABAMA & COUSHATTA
TUNICA
CHITIMACHA
COUSHATTA
MIKASUKI
SEMINOLE
CHEROKEE
CATAWBA
SIOUAN
POWHATAN CONFEDERACY
SENECA
TUSCARORA
ONONDAGA
MOHAWK
PASSAMAQUODDY
PENOBSCOT
NARRAGANSETT
POOSEPATUCK

FIGURE 24.—PRESENT DAY LOCATION OF INDIAN TRIBES (From Reference 179)

1972 figures from the Bureau of Indian Affairs indicate that between 92-95% of school-age Indian children are attending classes, as opposed to 97-99% for the population at large.(198) Whether in or out of school, the youthful Indian population may be seen as a distinct target audience for educational programs incorporating bi-cultural and bilingual sensitivities.

b) Schools and Financing

There are several types of schools available to Indian children, although generally not all at the same time in the same area. (See Table 17.) Of the total Indian population, the school age population between 5-18 years old during 1972 was 213,245. Like other American students, Indian children may be educated in public or private institutions, with the variation that some of the schools are federally run (by the Bureau of Indian Affairs). Note that fully 9% of Indian children 5-18 years old are listed in either "Not in School" or "Unknown" categories. Although not listed in Table 17, a small number of students are enrolled in Indian-controlled schools which may be very significant in the future, both politically as well as educationally. Of the students in BIA schools, approximately one-half are from the Navaho tribe and 9 tribal groups account for 86% of BIA school attendance.

Potential in-school delivery points for educational materials via telecommunication would include the estimated 1,000 public schools with Indian students, the 199 BIA institutions, and the 150-200 mission schools. These institutions are staffed by an estimated 7,000 elementary and secondary teachers distributed as follows: 4,900 professionals in public schools serving a predominantly Indian student body, 1800 teachers in BIA

TABLE 17.—Types of Schools and Enrollments of Indians Ages 5-18 in 1972 (Source: BIA)

Category	Number	Percentage
Federal (BIA) Schools	48,605	22.7
Public Schools*	138,519	64.9
Mission and Private Schools	10,087	4.7
Not in Schools	9,119	4.2
Unknown	6,915	3.2
TOTAL:	213,245	

---

*Approximately 40% of students attending public schools received Johnson-O'Malley funds.

institutions, and 300 staffers in private schools. The number of teachers reaching Indians is swelled to an estimated 12,000 if one includes those who have two or more Indian pupils. Fuchs and Havighurst estimate 3,000 individuals teaching in towns and rural settings with approximately 5-15 Indian students, and the remaining 2,000 working in areas of 50 thousand population or more with about 2-5 Indians in their classes.(196) Most of the teaching staff is not Indian; the BIA employs the highest percentage of native instructors with 11% of its staff. Although cultural differences separate many Indian students from their teachers, specific staff training programs to lessen the gulf are rare. This absence is reinforced by few contacts between the native community and the school, plus the general dilemma of teaching in an isolated area.

Financing of Indian education occurs mostly through the federal government resulting from responsibilities outlined in treaties. Of the 213,248 Indian students aged 5-18 in 1972, about 45,000 are now attending public schools financed by local taxes. Two-thirds of those attending public schools receive Public Law 874 federal funds from the U.S. Office of Education in lieu of taxes. The Johnson-O'Malley Act of 1934 and 1936 allows the BIA to contract with state and local agencies for services to Indians and to supplement P.L. 874 funds. BIA schools are funded through the Department of Interior. In 1968, a total of 126 million dollars in federal funds for these three programs were expended.(179) In FY 1972, the BIA spent $540,000 in an educational personnel training program.(87)

c) Bilingual Education

Student-centered programming should have special consideration for the Indian audience. Indian students tend to be older than their Anglo counterparts in the same grade, to fall increasingly behind standardized norms from 7th grade on, and to approach school with varying degrees of facility in English. Precisely how many Indian school-age children totally, or primarily, lack English language skills is unclear. 1970 Census figures indicate 56,493 non-English speaking school-age Indians; Perrine has estimated 70,000 based upon 1972 BIA statistics.

Of the total Indian population in the U.S., 50 percent listed English as their mother tongue in the 1970 Census while only 32 percent listed an Indian mother tongue. Only 25% of reservation Indians list English as their mother tongue. Of those reservation Indians who speak an Indian mother tongue, five language groups comprise 72% of the population (Navajo is the largest group) and fifteen languages generally spans the entire population.(179)* Overall the ability to speak English appears to be becoming more prevalent.

One view of the importance of bilingual education is put forth in a 1970 article by Fuchs:(197)

> "The complexity of the curriculum problem is indicated by the fact that even today two-thirds of all Indian children entering BIA schools have little or no skill in English. There are nearly 300 Indian languages in use today; more than one-half of the Indian youth between the ages of six and eighteen use their native tongues. All Indians express a concern that the schools teach English, and experience indicates that programs in Teaching English as a Second Language (TESL) provide a more valid and humane way to teach English than to depend upon exposure. TESL programs have been developed and instituted, but funding language programs

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*It is interesting to note that there are also 15 official languages in India.

> in both BIA and public schools is a perennial problem, Of the $7.5 million appropriated for the National Bilingual Education Act, only $300,000 is being spent on Indian programs benefiting 773 children."

Hopefully the situation has improved somewhat. The 1974 estimate for Bilingual Education was about $40 million.(87) The Education Amendments of 1972 established a bureau-level Office of Indian Education in the Office of Education. 1972 witnessed three bilingual projects in BIA schools among the Navajo, Pueblo, and Sioux tribes. These efforts may have important ramifications both for software production and/or modification, and their usefulness in acquainting isolated students with the concept of bilingualism. An offshoot of the Navajo project is the Multicultural Teacher Education Center at the Rough Rock Demonstration School in New Mexico. The Center is designed to train teachers and supportive personnel in utilization of bicultural and bilingual techniques with Navajos. The National Indian Training Center has been established at Brigham City, Utah, with partial funding from the Civil Service Commission. This Center's media orientation, if any, remains undefined, but it may serve as the training ground for native technical and management personnel of the future.

d) Indian Educational Telecommunications Projects

Use of telecommunications to date has primarily been community-inspired or community oriented. Generally, this new community awareness has taken two forms: 1) interest in native-run broadcast operations, and 2) interest in the established media providing relevant programming to Indian audiences. An example of the former is Ramah Navajo Radio, operating at 89.7 MHz on the FM band, 12 hours a day, 6 days a week. Serving the Ramah Navajo Community over 1000 square miles of eastern New Mexico, the station is licensed to the native school board of the community high school. Begun in April, KTDB addresses itself to community educational and informational needs. To accomplish this, much programming is done in Navajo with a predominantly native staff. National Public Radio tapes are used as are tapes concerning Alaskan and Canadian Indians, and a UPI teletype is rented to prevent extreme localism while encouraging knowledgeable understanding of the world at large. Overall operating expenses for 1973-1974 are figured at $80,000.00; initial hardware costs were met by the Office of Economic Opportunity and the BIA and included 200 transistor radios to blanket the target audience of approximately 1400 people comprising 230 families. Radio KTDB, a call-letter acronym for the Navajo "radio of the people," reports enthused community response.

Carrying this operational idea one step further, both the Navajo and New Mexican Pueblo nations maintain special staffs to access the mass media with communications of importance to them. At present the plans of each nation are autonomous and future activities depend upon available funds. The Navajo nation placed 11 hours per week of relevant programming on local television stations during the fall of 1973, and had established two corporations to finance, produce, and distribute future material. The All Indian Pueblo Council is in the pre-operational stage and is concentrating its efforts upon the establishment of a newspaper, radio station, and media school, the latter to be called the National Center for Indian Media Training.

Another telecommunications project which lacks the strong community involvement of the Ramah Radio Project is the in-school CAI demonstration at the BIA grammar school in the Isleta Pueblo south of Albuquerque, New Mexico. Ten teletype terminals serve 285 students with computer-assisted instruction (CAI) in math, Language Arts, and reading originated at Stanford University in Palo Alto, California. The CAI are drill-and-practice and the software was not developed especially for use with Indian students. Perrine reports mixed reaction to the project after a visit.(179) Project personnel reported learning gains on the part of the students. Problems centered on lack of coordination with other classroom materials and difficulties in separating the results of the CAI project from other experimental efforts. Satellite interconnection of Palo Alto with Isleta Pueblo did not materialize as originally envisioned, resulting in the rental of telephone lines for interconnection at $1000.00/month and the eventual installation of an on-site minicomputer to eliminate the unreliability of the interconnection.

e) Conclusion

Whether telecommunications will aid in improving conditions that have plagued Indian education is open to demonstration, and may well depend upon such factors as suitable software and emphasis upon local (native) inputs to planning and production. There are indications that some native groups would want to develop local telecommunications systems relying upon their tribal language. Therefore, a combination of both a nationwide network with access to general material and, in addition, local stations for local broadcast capability may be optimum. Small-scale technologies such as audio cassettes and slides may play an important role. Concepts underlying Indian education are in a state of flux, changing from a paternalistic-assimilatory bent to one emphasizing independence and cultural pride. Talk of change is abundant, yet actual change comes slowly; in this atmosphere some issues assume an importance which may allow them to influence ensuing developments. Among these are the release of federal monies to Indian constituencies to effectuate native control of schools, new mixes of standard curricula with native heritage components and native languages, and the resultant delicate balance necessary to reduce the isolation of the 55% of American Indians living in rural settings from the mainstream Anglo society.

5. Black Americans

a) Introduction

According to the 1970 Census, there were 22,580,289 Black Americans in the United States.(199) Blacks or Afro-Americans constitute some 11% of the U.S. population and are by far the largest of the minority groups discussed in this section of the report. The school age Black population is even higher. Over 15% of all public elementary and secondary school students are Black.(87) Some 81% of the Black population now lives in urban areas. The only section of the country in which the Black population is predominantly rural is the south.

The history of the United States during the past 20 years has been inexorably linked to the struggle of Black Americans to achieve equal opportunity under the law. Part of that struggle has centered upon the lack of educational opportunity which was recognized in the U.S. Supreme Court decision of 1954. Since then, Blacks have been at the center of change and innovation in education, including technological innovation, as will be seen in the next section.

Blacks have made tremendous strides in education in recent years. According to a 1970 Census report entitled "We the Black Americans":(199)

> ". . . . black parents today have had about 4 years more schooling than the preceding generation. The average number of years of schooling in 1950 was 7; today it is about 11 years.
>
> "Today's black children are doing even better. The number of blacks aged 16 and 17 attending high school has increased from 77 percent in 1960 to 86 percent in 1970.
>
> "Sixteen percent of our young people are attending college today. Six percent of us in the 25 to 34 year age group have graduated from a university."

These strides, however, are but a part of what is required to overcome the vestiges of a system of slavery and discrimination which prevented Blacks from seeking education. The Coleman report(27) documented lower achievement of standard achievement tests by Blacks in 1965. A 1969 National Assessment of Educational Progress in Science indicated poorer performance by Blacks. (See Table 18 .) A greater percentage of Blacks than Whites are classified as high school dropouts. (See Table 7.) Fewer Blacks than Whites percentagewise graduate from college. Although Blacks constituted some 8.7% of first-time enrollments in institutions of higher education in 1972, statistics seem to reflect fairly high attrition rates (see Table 19). For a detailed analysis of Afro-Americans in higher education, see Johnson.(90)

The 1960's were a period in which extensive federal legislation was passed directed toward improving educational opportunities for minorities. Among the legislation were the Civil Rights Act of 1964, the Economic Opportunity Act of 1964, the Elementary and Secondary Education Act of 1965, the Higher Education Act of 1965, the Adult Education Act and the Elementary and Secondary Education Amendments of 1966, the Education

TABLE 18.—National Assessment of Educational Progress in science, by age and by selected characteristics of participants: United States, 1969

Selected characteristics of participants	Participants, by age							
	9-year-olds		13-year-olds		17-year-olds		Young adults (ages 26–35)	
	Median percent correct	Median difference[1]	Median percent correct	Median difference[1]	Median percent correct	Median difference[1]	Median percent correct	Median difference[1]
1	2	3	4	5	6	7	8	9
Total	68.3	.....	58.4	.....	47.1	.....	51.3	.....
Region:								
Northeast	71.6	2.3	62.2	2.0	49.1	2.6	53.6	0.6
Southeast	60.9	−5.0	49.6	−4.7	39.9	−4.9	42.7	−4.9
Central	71.3	1.6	60.3	1.9	47.7	−.0	51.8	.7
West	67.4	.0	57.5	−.5	48.6	1.7	54.2	2.4
Sex:								
Male	70.1	9	60.8	1.5	51.2	2.8	57.9	5.3
Female	67.5	−9	56.1	−1.4	44.6	−2.3	45.8	−4.7
Color:								
White	72.7	3.1	62.6	3.2	48.9	2.1	54.4	2.7
Black	47.7	−14.5	37.1	−15.0	29.7	−11.8	29.2	−15.8
Other	52.6	−10.3	45.0	−9.8	37.2	−6.8	43.4	−10.8
Parent's education:[2]								
No high school	55.2	−7.2	44.0	−11.8	35.0	−8.4	41.9	−7.9
Some high school	60.0	−4.8	46.9	−6.1	35.3	−7.6	46.1	−1.6
High school graduate	69.4	6	55.4	−1.3	48.8	.1	55.2	3.0
Post high school	76.7	5.8	65.6	5.2	52.2	5.1	64.0	9.1
Unknown	61.1	−4.5	47.0	−7.7	33.0	−9.1	30.3	−16.8
Size and type of community:								
Extreme rural	57.8	−6.3	47.5	−6.1	37.3	−3.5	45.2	−4.7
Extreme inner city	41.4	−15.1	30.1	−13.7	35.6	−7.3	34.5	−10.2
Extreme affluent suburbs	73.5	7.3	67.4	6.3	57.2	5.1	64.8	10.9
Inner-city fringe	64.2	−2.0	52.7	−3.8	47.1	.3	48.6	−2.9
Suburban fringe	71.4	2.7	62.6	2.9	46.8	1.0	51.5	.8
Medium city	69.0	8	61.5	1.9	47.8	1.3	52.4	.3
Small city	69.7	9	56.8	.5	44.1	−1.4	46.7	−2.7

[1] Median differences of group performance from the national performance over all exercises (items).

[2] Highest attained by either parent.

SOURCE: Taken from first-cycle [illegible] the National Assessment of Educational Progress, 1860 Lincoln Street, Denver, Colo. 80203. October 1972.

TABLE 19.—Total enrollment, fall 1972, and degrees conferred, 1970-71, in institutions attended predominantly by black students: United States

Item	Total	Four-year institutions[1]			Two-year institutions		
		Total	Public	Private	Total	Public	Private
1	2	3	4	5	6	7	8
Number of institutions	114	90	36	54	24	14	10
Total enrollment	246,219	189,897	130,281	59,616	56,322	53,752	2,570
Men	116,875	90,263	61,395	28,868	26,612	25,440	1,172
Women	129,344	99,634	68,886	30,748	29,710	28,312	1,398
Full-time enrollment	181,733	153,099	99,015	54,084	28,634	26,333	2,301
Men	88,181	73,577	47,395	26,182	14,604	13,497	1,107
Women	93,552	79,522	51,620	27,902	14,030	12,836	1,194
Part-time enrollment	64,486	36,798	31,266	5,532	27,688	27,419	269
Men	28,694	16,686	14,000	2,686	12,008	11,943	65
Women	35,792	20,112	17,266	2,846	15,680	15,476	204
Earned degrees conferred:							
Bachelor's and first professional	26,423	26,423	10,070	16,353	.....	.....	.....
Men	11,197	11,197	4,356	6,841	.....	.....	.....
Women	15,226	15,226	5,714	9,512	.....	.....	.....
Master's	4,121	4,121	1,264	2,857	.....	.....	.....
Men	1,821	1,821	537	1,284	.....	.....	.....
Women	2,300	2,300	727	1,573	.....	.....	.....
Doctor's	47	47	47	0	.....	.....	.....
Men	40	40	40	0	.....	.....	.....
Women	7	7	7	0	.....	.....	.....

[1] Colleges and universities offering bachelor's and/or advanced degrees.

NOTE.—Total enrollment includes students whose programs of study are creditable toward a bachelor's or higher degree and also undergraduate students in 1-, 2-, or 3-year occupational programs which are not creditable toward a bachelor's degree.

SOURCES: U.S. Department of Health, Education, and Welfare, Office of Education, *Fall Enrollment in Higher Education, 1972*, and *Earned Degrees Conferred, 1970-71*.

Professions Development Act and the Elementary and Secondary Education Amendments of 1967, the Vocational Education Amendments and Higher Education Amendments of 1968.(87) These programs contained a variety of legislation aimed at "disadvantaged" or "low-income" groups. Programs such as Title I, Title III and Title IV have been used to fund educational telecommunications projects. The 1972 Educational Amendments saw the establishment of a National Institute of Education and general aid for institutions of higher education, as well as increased emphasis on non-discrimination and affirmative action in hiring by colleges and universities.

In general, however, the strong thrust of the 1960's has become somewhat stalled. Many of the programs continue along to some extent and impact many of the educational subsectors discussed previously. Although some gains in reducing school segration have occurred of late, particularly in the south, calls for school integration as the key to equal educational opportunity have become more muted of late, in part as a result of a supreme court decision on busing.

These trends have been accompanied by the acquisition of increasing political power and educational achievement by Blacks. As Blacks assume their rightful places in the educational and governmental infrastructure, they seek ways in which to aid those in need. A growing concern is expressed for community control of schools, for the rediscovery and expression of a rich Black educational heritage, for the development of "Black Consciousness," for links to their African heritage.(200) And as Blacks begin to penetrate professions such as science, engineering and communications, they turn their attention to ways in which technology and telecommunications may be used for the benefit of Black people.

b) Use of Technology and Telecommunications*

An interesting phenomenon that emerges from examining educational technology projects is that many of them were targeted specifically for use with minority children. This is due in part to the fact that funds were available for efforts to improve education for the "disadvantaged" under the various federal social programs initiated in the 1960's. In fact, other innovative programs not necessarily involving technology emerged in the same manner, such as vouchers and performance contracts. Many of these efforts, including the technology-based ones, were geared towards improving cognitive skills.

Perhaps the outstanding example of a nationally accepted educational television program is Sesame Street, delivered via public television. (See Section IIG5c.) This program was developed to demonstrate the effectiveness of television as a medium for teaching pre-school children. The setting of the program was an inner-city setting. Viewers made gains in learning of certain basic facts and skills. There appeared to be no differences in the program's impact on black and white disadvantaged children, who if they watched as frequently, did as well as advantaged children.(156) According to the ETS evaluation, "The program apparently is having an impact on the attitude of its viewers towards school and towards people of other races."(156)

The follow-up program to Sesame Street, "The Electric Company," had a clear and significant impact on its primary audience -"second grade children who were in the bottom half of their class as indicated by standardized reading test scores - indicating the program was an effective instructional supplement for children who were beginning to experience reading difficulty."(202) The program was reported to have had a similar effect on all groups who viewed in school - Spanish background, blacks, whites, boys and girls.(202)

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*Two Master's theses have been undertaken which provide extensive information and analyses on telecommunications and Black education. The reader is referred to these works by Molden and Johnson for further information. (200, 201)

These two programs illustrate the educational potential of television and the importance of public broadcasting. A primary concern of Black groups and individuals is for meaningful programming and participation in public television and radio. For further information, see the study by Molden.(200)

Another technology of interest and concern to Blacks is cable television. Cable television offers the possibility of developing and distributing a diversity of programming of interest to local communities, albeit at a monthly cost to home viewers. Blacks have been active in seeking franchises for ownership of cable stations. The Cable Communications Resource Center in Washington acts as a resource for minority groups interested in cable.

A developing technology which has been implemented in large urban school systems is computer-aided instruction (CAI). Jamison, Suppes and Wells have recently reviewed an extensive number of CAI experiments and demonstrations.(203) They found that although no uniform conclusions can be drawn about the effectiveness of CAI, at the elementary school level it can be used in some situations to improve achievement scores in reading and math, particularly for disadvantaged students.(203) Furthermore, it may also result in substantial savings in student time in some cases.

This discussion only scratches the surface of the interrelation between Blacks and educational telecommunications. Both local and national projects have been and are being carried out, which were sold on the basis of their ability to aid Black children and which affect their lives. These projects are undertaken with varying degrees of Black involvement and control (or lack thereof). It may be true, as David Reisman points out, that computers and other teaching devices are not susceptible to threatening prejudices or attitudes that students - often minority students - sense in their human teachers which can block effective learning.(101) On the other hand, someone programs the software for the computer. Furthermore, someone must bear the financial burden after the innovative phase is over, which may be difficult to do in hard pressed, less affluent school districts.

Hopefully, growing involvement of Blacks in educational telecommunications and enlightened governmental policy shaped in part by growing numbers of Black professionals will succeed in finding ways to use educational technology for the benefit of all people.

6. Spanish Origin, Surname or Heritage Americans

The Spanish Origin population of the United States is composed of some 10 million people and is predominantly urban. The 1970 Census gives a total of 9,072,602 for "All persons of Spanish origin" and of these, 7,912,652 or 87 percent are living in urban areas.(179) According to a March, 1974 article, there was an undercount in the 1970 Census and the total Spanish origin population was about 10.6 million in 1973.(204)

The arguments for bi-lingual education are particularly strong for the Spanish-origin population in the U.S. Some 96.4% of this population are considered as being of the Spanish language.(179) Roughly 60% of the total are Mexican-Americans, with the rest of the population originally from Puerto Rico, Cuba, Central or South America or other.(128) Over 80 percent of Mexican-Americans reside in a five-state area that includes Texas, New Mexico, Colorado, Arizona and Florida. Chicago and New York City have about 65% of the total Puerto Rican population living in the continental United States.(128) About one million people of Spanish "heritage" live in rural areas.

The educational situation of the Spanish heritage population is in some ways similar to that of Black Americans described in the previous section. Although major strides in educational achievement have been made in recent years, much remains to be done.(205) Increasingly, Mexican-Americans (Chicanos), Puerto Ricans and others are attempting to improve their lives by their own initiatives.

Educational telecommunications projects, if they are to be meaningful for Spanish origin Americans, must take into account their linguistic and cultural heritage. During the second year of operation, "Sesame Street" introduced simple skills in the Spanish language.(156) More significantly in 1972, the Office of Education provided $800,000 to the Berkeley Unified School District in California to establish a Bilingual Children's Television Workshop as a major test of television as a medium for improving language instruction and cultural awareness. Drawing in part on experience with Sesame Street, "the project is seeking to develop a daily nationwide program that will deal with the school readiness problems of Spanish speaking children and at the same time broaden the cultural horizon of English speaking children."(118) Other initiatives by Chicano and other groups can be and are taking place with regard to media such as broadcast television, cable television and radio.

7. Appalachia*

a) Introduction

> "Appalachia is an American enigma. It is a region rich in natural beauty and resources lying close to the vast industrial-urban complexes of the Midwest and Northeast; and it is inhabited largely by people who represent the American archetype in terms of ethnicity, religion, patriotism, and a ruggedly independent life style. Yet these same people, many of colonial stock, have not shared fully in their nation's social and economic progress for nearly two centuries. Appalachia is a depressed region." (207)

Figure 25 depicts the Appalachian region as defined by Congress in the Appalachian Regional Development Act of 1965 and 1967 Amendments to the Act. As is evident from the map, the Appalachian region encompasses the entire state of West Virginia and portions of twelve other states - Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee and Virginia. The total population of the region is in excess of 18 million people with over half the population living in rural areas.(208) Population is spread over some 392 counties in the states and four independent cities not found in counties. Taken as a whole, the Appalachian region has the following features: a low per capita income as compared with the rest of the U.S., mountainous terrain, and a rather fiercely independent populace that is 92.8 percent Caucasian. However, analysis of the various economic and geographic areas of the vast Appalachian regions suggests that there are four definite sub-regions, or four Appalachias, with characteristic problems and potentials unlike those of any other section of the region.

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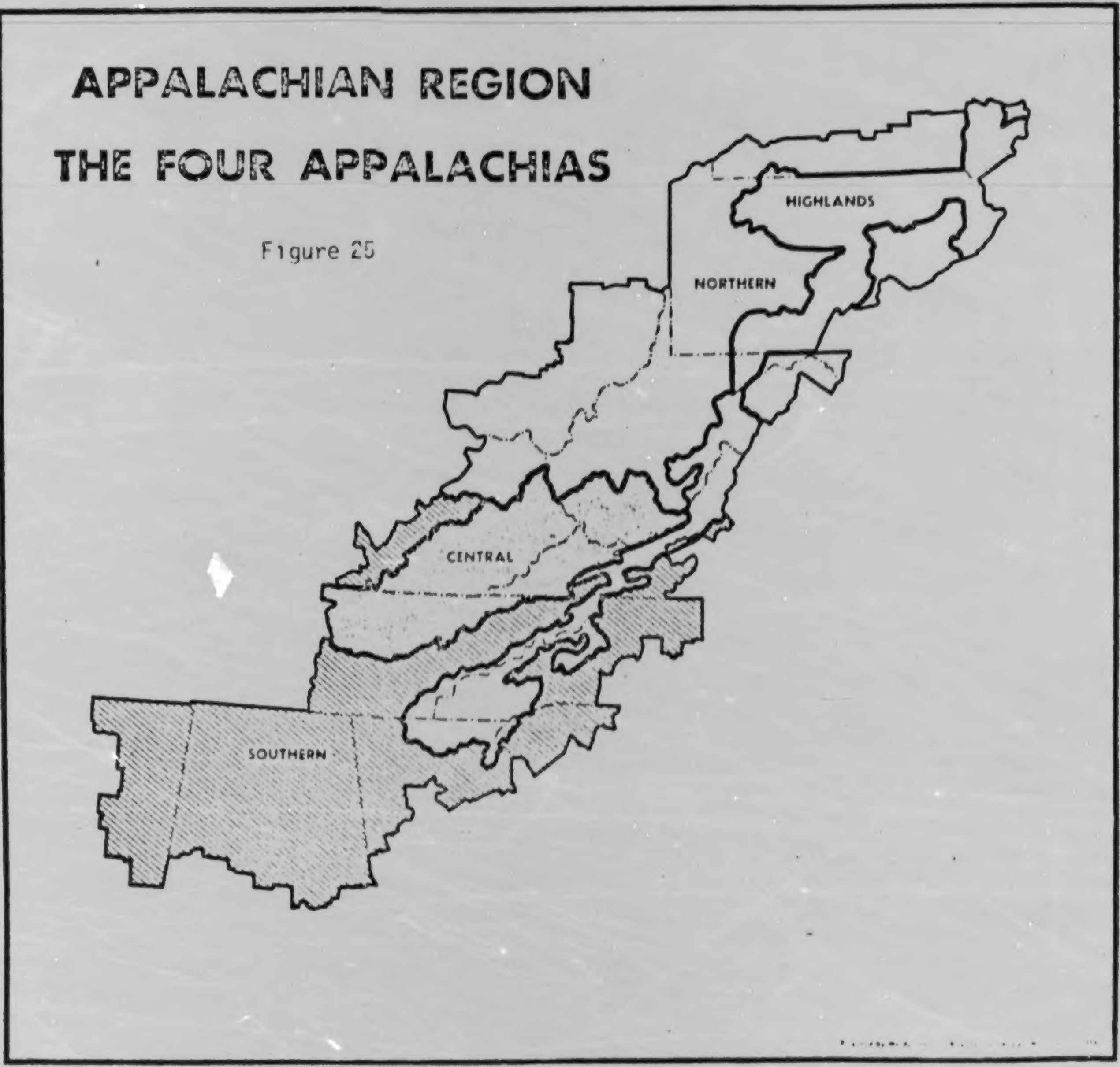
*The material in this secion is based upon a study entitled "Communications Technology for Education and Health Care Delivery in Appalachia" prepared by Singh, Morgan, et al., Center for Development Technology, for the Appalachian Regional Commission, 1972. For further details and documentation, see the study report. (206)



APPALACHIAN REGION

THE FOUR APPALACHIAS

Figure 25

HIGHLANDS
NORTHERN
CENTRAL
SOUTHERN

Most populous of these four sub-regions is Northern Appalachia. According to the 1970 Census, it had 48.3 percent of the entire Appalachian population residing in it. Geographically it includes the southern tier of New York, and most of the Allegheny Plateau area in Pennsylvania, Maryland, northern West Virginia, and southern Ohio. This part of Appalachia has problems related to the transition from dependence on a coal-steel-railroad economy to new types of manufacturing and service employment. "Many communities in this region suffer from environmental problems, legacies of past industrial and mining activities, including mine drainage pollution, mine subsidence, blight from strip mining, and mine fires and flooding."(209)

Southern Appalachia is the second of these four major sub-regions and accounts for 33.2 percent of the total Appalachian population. It covers all Appalachian counties in Mississippi, Alabama and South Carolina and a number of Appalachian counties in Tennessee, North Carolina, and Virginia. Industrialization and urbanization are occurring here quite rapidly, converting the area from an agricultural economy to manufacturing and services.

The Appalachian Highlands sub-region begins near Mt. Oglethorpe in Georgia and extends through the Great Smoky, Blue Ridge, Allegheny, and Catskill Mountains, covering parts of Georgia, South Carolina, Tennessee, North Carolina, Kentucky, Virginia, West Virginia, Pennsylvania, and Maryland. The Highlands is a sparsely populated segment of Appalachia, accounting for 10.9 percent of the Appalachian population.

The last of the four sub-regions and the poorest in terms of real per capita income is Central Appalachia, consisting of 60 counties in eastern Kentucky, southern West Virginia, southwestern Virginia, and northern Tennessee. Its population of over 1.5 million people represents 7.6 percent of the total Appalachian population. Only 250,000 people live in communities of more than 2,500. Per capita real income in this region is 52.9 percent of the national level. It is the only sub-region that has lost population in the last decade (-10.7 percent population change in the period 1960-1970) due to out-migration in search of better job opportunities. Here the choice appears to be between faster growth through better transportation, communications, education, and development of new kinds of job opportunities on one hand or continued out-migration on the other.

b) Education in Appalachia

Educationally, the major cities in Appalachia compare favorably with those of the rest of the nation.(210) The problem lies in the isolated rural areas that are characteristic of the region. The underdevelopment of rural areas is reported to be the result of the abandonment of coal mines and isolation in the "hollows" and in part from marginal subsistence farming.(210) The drop out rate, although slowing, still averages 20-25 percent higher than that of the nation. In some areas of Appalachia, it is as high as 71 percent between first and twelfth grade compared with a comparable estimated national average of 36.2 percent. Such a high drop out rate results in undereducated and underskilled youth.

Another major indication of the unmet educational needs is the low average educational attainment. Ten of the thirteen Appalachian states have illiteracy rates higher than the national average of 2.4 percent, with Alabama, Georgia, Mississippi, and North Carolina topping the four percent mark, and South Carolina higher than five percent. The situation is reported to be especially acute with non-Caucasian elements of the population in Appalachia. The rate of failure for Appalachian youth on Selective Service tests is 18.3 percent compared to the national average of 12.4 percent (1966 data).(211) Excluding the Appalachian counties of New York and Pennsylvania, only four Appalachian counties equalled or exceeded the national median number of school years completed (10.6) by persons 25 years old and over in 1960. Eleven percent of Appalachian adults (25 or older) had completed less than five years of school as compared to a national average of 8.4 percent. The national average of adults completing high school was 41.8 percent in 1960, as compared to 32.3 percent for Appalachia.

Isolation and the rather thin spread of population in many areas have additional effects. Although property taxes may be lower in Appalachia, the percentage of per capita income devoted to education is higher than the average for the rest of the nation. However, although Appalachia expends a higher percentage of its income on its pupils, Appalachian children still have almost $200 less per year spent on their education than the average pupil in the country; their teachers receive $2,000 less per year.(211, 212) Budgets in some school districts, where substantial consolidation has been achieved, must allocate over 50 percent of their total expenditures for transportation because of low population density and hence spend considerably less money per pupil for instructional programs.

Budgetary problems are also reflected in poor instructional facilities. Appalachia is reported to contain over 1,000 one- and two-room schools, more than any other comparable region of the country. In 1965, it was estimated that over 35 percent of the instructional classrooms in the U.S. built before 1920 were in the thirteen Appalachian states. To meet recommended pupil-per-classroom ratios, these thirteen states would require classrooms totalling over 40 percent of the school construction needs of the country.(211) Old and crowded classrooms not only present a hazard to safety of children, but also seriously inhibit the introduction of new education practices such as team teaching, upgraded instruction and other methods of increasing the freedom and individualization of instruction.(211)

Because of the low salaries and work in rural areas, Appalachia also suffers from lack of qualified education personnel - teachers, teacher's aides, counselors, and supervisors. According to the report of the Education Advisory Committee,(211) four Appalachian states reported having no psychological services personnel, two states reported one each in their Appalachian regions, and three reported 16 or less. It is also reported that 13 percent of the teachers in the region do not have complete certification as compared with the national level of 5.6 percent. Less than 85 percent of the teachers in Appalachia are reported to have the B.A. degree while the national level is 95% (according to 1967 NEA statistics). While the nation's supply of teachers exceeds the current budget-limited demand, the Appalachian region is facing a shortage of adequate personnel. Most Appalachian states are reported to be exporters of teachers. Pay differentials and lack of placement cooperation between school districts and institutions of higher learning are held responsible for this.

According to a report prepared by the Education Advisory Committee of the Appalachian Regional Commission on the status of secondary vocational education in Appalachia,(213) vocational education at the secondary level in Appalachia is inadequate in scope. Federal funds tend to support vocational education slightly more outside Appalachia than within Appalachia. However, a more serious problem lies in the fact that the bulk of vocational enrollments within Appalachian secondary schools do not correspond to current or projected job openings. More jobs are being created by economic growth within Appalachia than the secondary schools are producing graduates to fill. The shortage of skilled labor could very well inhibit the economic growth of Appalachia. Vocational secondary schools seem to be emphasizing agricultural, distribution, home economics, and office vocations. At least in two of these areas (agriculture and home economics) the employment outlook is not good - there are fewer average annual job openings projected for the near-term future than the output of secondary schools in these vocations. The imbalance is more obvious in health, technical, and industrial vocations where the output is far short of the demand. There is clearly a need for a vocational information system for the region and comprehensive regional planning to keep the vocational secondary schools in tune with the actual regional demands for skilled personnel.

c) Appalachian Regional Commission Programs for Action in Education

The Appalachian Regional Commission, in a study published in 1971, set forth the following priority points of intervention to correct existing educational deficiencies in the region:(211)

(a) Child development and early childhood education (prenatal through grade 4 or age 10).

(b) The restructuring of all school curricula to greater occupational relevance by providing career orientation and work experience as early as possible, but with emphasis on grades 7-9 where the highest drop-out rates occur.

(c) The provision of job relevant opportunities for training from high school through adult programs.

(d) Special planning, funding, and technical assistance to develop a system of multijurisdictional regional agencies both to provide basic services to groups of small districts and to develop model programs in the priority areas shown above.

(e) The development of educational manpower for the improvement of the quantity and quality of teachers.

(f) Comprehensive statewide planning to develop, manage and coordinate educational activities.

As is obvious from the above listed priorities, the thrust is in four areas: child development and early childhood education; education manpower development; occupational information dissemination, career orientation, and work exploration; and development of regional education service agencies.(214)

d) Educational Telecommunications in Appalachia*

An examination of American Research Bureau (ARB) data based on sampling shows that some 89.3 percent of the households in the Appalachian region have television sets, somewhat below the national figure of 96 percent. Among Appalachian portions of the thirteen states in the region, Georgia is at the high end of a rather narrow range with 93.7 percent of households with TV sets compared with 82.5 percent at the low end for Kentucky. It is interesting to note that more households in Appalachia have television sets (89.3%) than have telephone (76.6%).(215)

Of 6.124 million households in the Appalachian region (some 9.3 percent of the nation's households), according to the 1970 Census,

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*Much of the information developed in this section was based upon survey results obtained in the course of the CDT study for ARC. (206)

1.218 million or some 20 percent subscribe to commercial cable-television systems. This is considerably higher than the current national level where some 5.3 million CATV subscribers are reported(216) out of some 65.5 million potential TV households,(215) i.e., only 8.1 percent of the total U.S. households subscribe to CATV service. Thus, some 23 percent of the nation's CATV subscribers reside in the Appalachian counties.

A survey of available data in the Broadcasting Sourcebook and Television Factbook (1971-1972) dispels the commonly held view that most of the cable-television facilities in the Appalachian region have rather small channel capacities, i.e., capacities in the range of 1-3 channels. The available data suggests that although many small capacity systems exist, particularly in Central Appalachia, the average channel capacity for CATV systems in the region is in the range of 8-10 TV channels.

There is little information available on the utilization aspects of the cable-television systems in the region - unused channel capacity, carriage of ETV broadcast as well as local ITV signals, and non-broadcast services in the public interest.

As of 1971, there were some 40 educational radio stations located in the region but only nine of them were affiliated with National Public Radio (NPR), the nation's public radio network. An examination of the educational radio data in the thirteen Appalachian states suggests that in New York, Virginia, and Georgia, the ER coverage of the Appalachian counties is inferior to that for the non-Appalachian areas of the states. ER coverage of the region is also inferior to that of ETV for the region. Indications are that there is negligible instructional programming on the ER stations in the region and the total emphasis is on information and entertainment oriented programming for the general community and specialized interests therein.

The early 1971 data indicates that the Grade B coverage contours of some 43 educational television (ETV) broadcast stations fall in the region, either totally or partially. (See Figure 26.) Respondents to a survey report use of eleven translators within the region to extend the coverage of ETV stations.(206) By adding up the population pockets that do not fall in the Grade B contours of any ETV stations, it is estimated that some 15 percent of the people in the region do not have access to an ETV signal. In actual practice, we expect this number to be higher by some 5 to 15 percentage points because there are also a large number of small pockets within the theoretical coverage contours where the line-of-sight ETV signal is blocked by the mountainous terrain. Survey respondents indicate plans for nine additional transmitters which will provide service to the region as well as an unspecified number of translators (in excess of 17) for the near-term future.

The ownership of the ETV stations serving the Appalachian region falls into three different groups - state owned, owned by non-profit community organizations, and university owned. These ownerships are reflected in the programming patterns and philosophies of these stations. Stations owned by community organizations emphasize programming for the general public whereas those owned by state agencies and universities in the region seem to have a more balanced schedule and seem to give equal time (primarily during the daytime) to instructional programming.

The ETV stations in the region are served by the national public television network, Public Broadcasting Service (PBS), and three regional

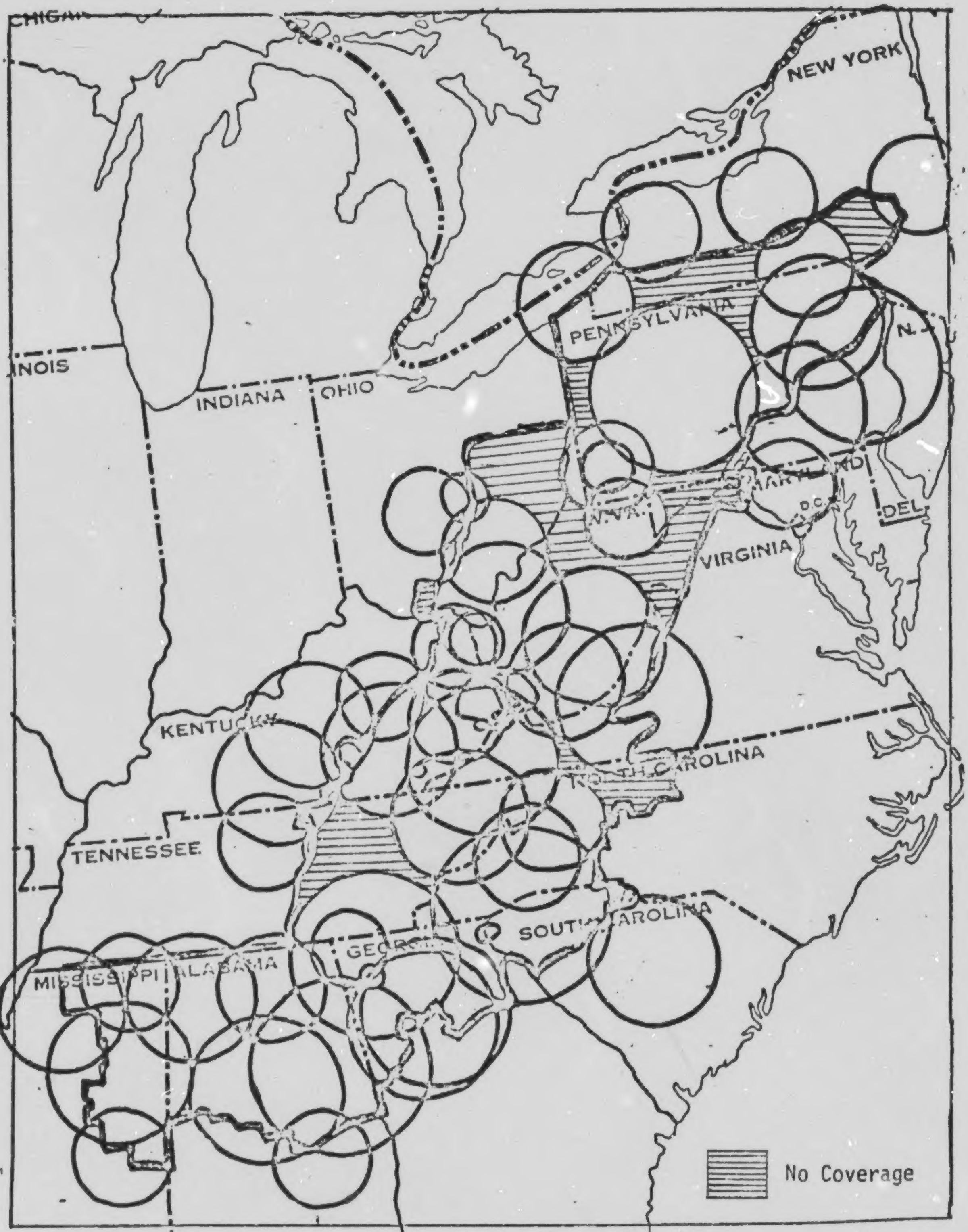
CHIGAN
NEW YORK
PENNSYLVANIA
N.J.
NOIS
INDIANA
OHIO
MARYLAND
D.C.
DEL
W.VA.
VIRGINIA
KENTUCKY
NORTH CAROLINA
TENNESSEE
SOUTH CAROLINA
GEORGIA
MISSISSIPPI
ALABAMA
No Coverage

Figure 26. Approximate Class B Contours of Public Television Stations Serving the Appalachian Region (1972) Ref. (206)

networks - Eastern Educational Television Network (EETN), Southern Educational Communications Association (SECA), and Central Educational Network (CEN). Although SECA is the nation's largest regional ETV network in terms of station affiliates, it ranks second in the Appalachian region to EETN in terms of populace reached by the network affiliates.

In addition to the national and regional networks, as of early 1972, ten of the thirteen Appalachian states had intra-state ETV station interconnection facilities. Seven of the thirteen states have their ETV stations completely interconnected and one state (Mississippi) has a complete interconnection system under construction. The Appalachian states with complete interconnection facilities are: Alabama, Georgia, Kentucky, New York, North Carolina, Pennsylvania, and South Carolina. States that do not have any interconnection facility are Maryland, Virginia and West Virginia. Tennessee and Ohio have partial interconnection of their ETV stations. The interconnection systems in Alabama, North Carolina, Ohio, and Tennessee are state-owned and those in the remainder of the states are leased from common carriers. These interconnection facilities represent a capital investment of over $6.4 million for state-owned systems and an annual payment in excess of $3 million for those based on channels leased from common carriers.

Although these intra-state networks are primarily designed for the distribution of ETV signals to broadcast stations, many offer limited two-way communication capabilities, more than one channel, and interconnect educational institutions and hospitals. The South Carolina network is capable of handling eleven video signals, Pennsylvania nine, North Carolina six and Kentucky three. In South Carolina, the facility interconnects some 218 schools, 17 university campuses, 9 hospitals, and 32 other institutions in addition to the interconnection of ETV broadcast stations.

There are six Instructional Television Fixed Service installations in the Appalachian region that are comprised of a total of seven transmitting stations and seven relay stations operating in the 2500-2690 MHz frequency band. The transmission capacity per installation is 2.3 video channels. All installations are licensed to local school boards. The Appalachian portion of Alabama accounts for four of the six installations in the region.

A survey of state ETV systems, and community and university owned ETV stations in the region suggests that in most instances public oriented programming dominates over that for in-school utilization and that many individual stations and state systems do little week-end programming. The majority of the programming aired by the state ETV systems, and community and university owned stations is acquired from outside sources. In the area of public oriented programming, the major sources of programming are Public Broadcasting Service (PBS), Public Television Library (PTL) at Bloomington (Indiana), National Educational Television (NET), and the three regional networks serving the stations in the region (EETN, SECA, and CEN). As compared with public oriented programming, a greater portion of the instructional programming aired by the stations is locally produced. However, acquisition from outside sources far outweighs in-house production. It is only in South Carolina that in-state production (65 percent in-state) dominates over acquisitions from out-of-state sources. In the ITV domain, the major sources of outside programming are: National

Instructional Television (NIT) at Bloomington (Indiana); Great Plains Instructional Television Library (GPITL) at Lincoln, Nebraska; and the three regional networks. The survey shows that NIT programs are aired in eight of the twelve state systems surveyed and six out of the eight community and university owned stations that responded to another questionnaire. GPITL supplies programs to six of the twelve state systems surveyed.

Responses to two survey questionnaires on state ETV systems and university and community owned ETV systems indicate that selection of ITV programming is highly complicated and localized. In the case of state ETV systems, selection is made by the state departments of education in conjunction with state ETV authorities and, in some instances, with teacher committees. Local ITV directors and local curriculum committees determine the ITV programs to be aired by community and university stations.

Returned questionnaires show that there is little being done by the ETV stations serving the Appalachian region in terms of specialized programming for the people in the region as well as in the areas related to health education and continuing education. Only five of the twelve state systems surveyed reported that their stations serving the region were airing programs specially tailored to the needs of the region. There seems to be a great deal of interest on the part of many state ETV systems (ten out of twelve that were surveyed) and individual stations (seven out of eight surveyed) for more specialized programming for the region. Health, adult basic education, vocational education, and community development were reported as the priority areas for specialized regional programming. Most respondents indicated a preference for a balanced mix of local and centralized production of the specialized programming. Only Alabama and West Virginia systems indicated a marked preference for local production.

Only five state ETV systems (out of twelve surveyed) and three individual stations (out of eight) indicated interest without any reservation in the suggestion for a common Appalachian inter-state interconnection system and feed. Five state ETV systems (Alabama, Georgia, New York, North Carolina, and West Virginia) responded unfavorably to their participation in such a network. The West Virginia response pointed out that such a move will accentuate Appalachian tendencies towards isolation. Some of the other respondents indicated interest in occasional interconnection and bicycling of tapes and pointed out that there is no need for a permanent interconnection arrangement. As to whether SECA should be responsible for the inter-state Appalachian feed and interconnection, the response *in aggregate* has been mixed. It appears that if such an interconnection is contemplated, SECA's management role will be acceptable to all only with a changed configuration for SECA and involvement of the other two regional networks serving ETV stations in the region.

A survey of ITV utilization in the Appalachian region indicates that with the exception of Alabama and Pennsylvania, the percentage of schools that have TV receivers for classroom use is smaller for the Appalachian parts of the states than for the non-Appalachian portions. However, Appalachian portions of at least four Appalachian states (Alabama, Georgia, Pennsylvania, and Tennessee) report higher percentages of schools with TV sets than the national average (75 percent). Furthermore, the Appalachian portions of Alabama, Georgia, Kentucky, Maryland, New York, Ohio, South Carolina, and Tennessee report a higher number of sets per school than the national average of 2.8.

The ITV survey suggests that ITV is used considerably more at the elementary level than at the secondary level and that not all the schools with TV sets are using them for instructional purposes. The dominant mode of ITV delivery is reported as broadcast television systems. Six states (Alabama, Georgia, New York, Ohio, Pennsylvania and South Carolina) have reported delivery of ITV programming to public schools through commercial cable-television systems.

As far as acceptance of ITV programming produced and delivered from a source not under local control is concerned, there seem to be severe problems primarily from the viewpoint of coordinating various curricula and obtaining and managing local involvement in program design and production. Our guess is that high quality programming from a centralized source in certain specific areas such as science, mathematics, etc. would still be acceptable as long as state authorities and/or local school boards are able to control the delivery mechanism.

In response to the question on the nature of additional programming state authorities would like to have, eight states have indicated interest in using additional quality programming in subject areas other than core-curricula. The top priorities seem to lie in health education, science, vocational education and contemporary affairs. Two states have indicated interest in high school equivalency programs whereas one has suggested development of programs on selected topics related to basic curriculum - single concept programs that an individual teacher could pull together into a program of his own liking.

A survey of 227 universities, colleges, and junior colleges in the Appalachian region indicates that about half of the institutions that responded to the survey (164 respondents out of 227 institutions) have a digital computer on campus and an additional 27 percent obtain some form of computing service from off-campus sources. Nearly half of the institutions with a computer on campus and a slim majority of colleges obtaining service elsewhere consider their existing computing facilities/arrangements adequate for their current need. A substantial majority of institutions that reported a shortage of computing services are willing to consider additional cooperative and shared services with other educational institutions. Time-shared computing was preferred among colleges which already have on-campus facilities by nearly four-to-one over remote batch. Less than ten percent of the institutions reported any excess computing power. Although less than one college in seventeen possess any real ability to share their surplus, they indicated their willingness to consider providing their surplus to other computer-poor institutions in return for proper compensation.

A survey administered to state health officials in the thirteen Appalachian states shows that telecommunications is primarily being used for providing emergency health services. There is little use being made of telecommunications in the region for remote diagnosis and consultation, consumer health education, and training of health personnel.

e) Potential Satellite Interconnection and Service Arrangements for Tele-education and Telemedicine in the Appalachian Region

Based upon extensive study of the educational telecommunications infrastructure in Appalachia, educational needs as perceived by educators and planners in the region, and other consulting inputs, the following suggestions were developed by Singh and Morgan as elements of potential future satellite interconnection and service arrangements for tele-education and telemedicine in the region worthy of further consideration:(206)*

(i) Direct satellite feed to low-cost earth-terminals feeding unattended low-power television and radio transmitters for extending educational television (ETV) and educational radio coverage to small communities that do not have access to ETV and ER signals and where terrain inhibits usefulness of conventional high-power VHF/UHF terrestrial transmitters.

Educational radio coverage in Appalachia is rather poor and in spite of some 40 plus ETV stations serving the region, it is estimated that 15-20 percent (the percentage is likely to be higher because only theoretical coverage contours are available) of the Appalachian population does not have access to even one adequate ETV broadcast signal. ETV and ER coverage can be extended to small communities in the hollows and valleys through the use of low-power unattended "transmitters." These transmitters can be fed by terrestrial microwave links, satellite, or video tapes. When a large number of such "transmitters" are to be operated, satellites have a distinct advantage; video-tape feed would require these transmitters to be manned and microwave interconnection would be difficult and costly to develop in the Appalachian terrain. For television signal dissemination, these low-power unattended transmitters would be very similar to modulators used to feed signals to cable systems. The difference would be that the signals from this "modulator" would be transmitted through the air rather than carried on cable. Programs could be viewed at any location within 1-2 miles of the transmitter depending upon the transmitter power output.

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*The suggestions outline broad potential opportunities for future satellite utilization. The Singh and Morgan study also identified specific tele-education and telemedicine projects for the ATS-F satellite for the Applachian region. (206) The Applachian Education Satellite Experiment now underway (see next section) is partly derivative of this study.

(ii) Direct satellite feed to cable-television systems in the region for delivery of educational/medical television programs to schools and homes interconnected to cable systems.

Some 20 percent of Appalachian households subscribe to cable-television services. Cable-systems offer a convenient and an important vehicle for dissemination of multi-channel programming to its subscribers. A satellite feed to cable systems can provide a valuable mechanism for the delivery of television programming related to public affairs and entertainment, specialized cultural programming for the region, in-school formal instruction, adult education, early childhood education, and consumer health education. It should be remembered that such diverse as well as specialized programming and coverage is impossible to achieve with over-the-air broadcast transmission. There is not enough frequency spectrum to permit such diverse programming requiring multiple channel broadcasts. However, it should be remembered that cable systems by no means insure automatic access of public service programming. Furthermore, the total population of the region to be served by cable will be determined by what is economically viable, unless there is a clear social policy which encourages the wiring of areas which might not be commercially profitable. These are matters which should be of major concern to the Commission, along with the question of the organizational and administrative framework for providing satellite distributed programming to cable systems.

(iii) Satellite interconnection of remote and isolated schools with resource centers and/or Regional Educational Services Agencies (RESAs) for resource sharing.

Such an interconnection, based on wideband reception and narrowband return uplinks at school sites, would permit students and teachers at remote institutions to utilize instructional services and resources such as Computer-Assisted Instruction, high-quality instructional television programs, computerized vocational guidance systems, etc., in a cost-effective manner by sharing such resources located at a central place with other resource-poor institutions. Such an interconnection could also potentially involve delivery of in-service teacher development services to keep teachers at remote institutions continously updated.

(iv) Interconnection of remote population centers and their local health-care centers with large and specialized central medical facilities for remote diagnosis and consultation as well as continuing education of remotely located medical professionals and para-professionals.

In spite of the substantial development of roads and highways in the Appalachian region, access to health-care centers is still a problem for quite a substantial portion of the Appalachian population, particularly for people living in the Central Appalachian region. Satellite interconnection of remotely located health-care centers with a large central facility holds forth the promise of effective utilization of para-professionals to provide quality medical care. The potential exists for broad geographical use of the services of a limited number of specialists through tele-diagnosis (remote interpretation of vital signs such as EEG, EKG, X-rays) and specialized consultation, as well as access to specialized medical data-banks. Such an interconnection, through the delivery of TV and CAI, would also facilitate continuous updating of the professional knowledge of remotely located medical professionals.

f) The Appalachian Education Satellite Project

The Appalachian Educational Satellite Project (AESP) is a "communications experiment demonstrating the feasibility of delivering via satellite in-service education courses and supporting information services to teachers in the Appalachian Region." The immediate educational objective of the AESP is to improve the effectiveness of the classroom teacher, thereby upgrading the quality of reading and career-education instruction available to Appalachian students. The question to be answered by the AESP and similar projects is, can the linking together of existing organizations, like the Regional Educational Service Agencies (RESAs), and communications satellites result in more effective and significant in-service teacher training."(143)

The AESP will involve the delivery of a mix of technology-based courseware via the ATS-6 satellite to some 15 sites in the Appalachian region. Technologies to be used include pre-taped video, live video with return audio, audio-based programmed instruction and computer-managed instruction. The project was initiated in the summer of 1974. Overall responsibility for project design, development and implementation was subcontracted by the Appalachian Regional Commission to the Center for Development Change, University of Kentucky which serves as the Resource Coordinating Center for the project. Funding and evaluation of the AESP is the responsibility of the National Institute of Education.(143)

8. Rocky Mountain States

The Rocky Mountain region is now the focal point for a major portion of the educational activity in the ATS-6 satellite demonstration. Extensive background information was gathered on the region and analyses performed in conjunction with preparation of a proposal for an Educational Technology Demonstration by the Federation of Rocky Mountatin States using ATS-6.(218) In this section, this information is briefly summarized and the Rocky Mountain experiment is outlined.

The region under consideration consists of eight states* containing eight million people, five major urban areas and 864,000 square miles of varied terrain. The region contains about 12 percent of all "Spanish-surnamed" persons, 30 percent of all Mexican-Americans and 30 percent of all American Indians in the United States. There are two primary routes for migrant workers in the region, involving 97,000 persons.(218)

The region has been characterized by a geography which creates communication and transportation barriers resulting in limited delivery of information and education-related services, which tend to be concentrated in urban areas. About 20% of the region's population has never received either commercial or educational television. Although 84% of the school population in the region has educational TV available in the schools,** this figure represents only about 50% of all school districts, reflecting the fact that there are many rural-isolated school districts with small student enrollments.

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*Arizona, New Mexico, Nevada, Colorado, Utah, Idaho, Wyoming and Montana.

**being used systematically to only a minor extent.

Among the characteristics of the region are a dearth of services in the early childhood education field and an economy undergoing important structural change from agriculture and light industry to a service orientation. These conditions coupled with other considerations led to the singling out of early childhood education and career education as early priorities for the Educational Technology Demonstration. Regional organizations such as the Federation of Rocky Mountain States and the Rocky Mountain Corporation for Public Broadcasting, along with the Educational Commission of the States, were key elements in mounting the interstate effort. The early childhood component was abandoned prior to the start of the demonstration due in part to lack of funding.

Key elements favoring use of satellite technology in the region included: 1) large geographic distances to be spanned and isolation due to barriers of terrain, sheer distance and adverse climate; 2) demographic unevenness; many widely dispersed small communities; 3) educational resource shortages and distribution inequities, and 4) inadequacy of existing telecommunications services. The above factors also served in many instances as constraints to be overcome in the experiment, in addition to such factors as linguistic differentiations, i.e, separate language groups (several Spanish dialects; Indian languages) organized into relatively distinct communities and dispersed throughout the region.

The Educational Technology Demonstration was designed after a detailed analysis of existing telecommunications infrastructure (CATV, Public Broadcasting Stations, Translators, etc.) within the Rocky Mountains. The experiment as it emerged is as follows.

The Rocky Mountain portion is the most extensive regional component of the ATS-6 Health Education Telecommunications Experiment. Starting in 1974, the satellite will transmit 81 35-minute television broadcasts on career education to fifty-six rural junior high schools and 12 public broadcasting stations throughout the region. Twenty-four of the junior high school sites have been equipped with "intensive terminals" to permit both transmission of audio and digital signals as well as reception of television programs. The satellite will also be used for in-service and pre-service training sessions for teachers as well as community group education on the project. An important feature is the use of relatively inexpensive earth receiving terminals ($2,700 each for receive only; $1,000 more for interactive capability) operating in the 2.5 GHz band. Commercial satellites currently available require ground receivers that are considerably more expensive.(145)

The Federation of Rocky Mountain States feels that the ATS-6 project will yield important information about costs and effectiveness of a large-scale, regional educational telecommunications system which will be crucial in determining future investments.(218) They have received conditional approval from NASA for a follow-on experiment with the CTS satellite.(219)

9. Alaska

According to Wigren, a UNESCO-NEA study team concluded that "Satellite communications for Alaska as part of an overall long-range educational communications system are not only feasible but necessary. In fact, the satellite was "invented" for Alaska!"(220) This emphatic conclusion was arrived at because of a variety of factors including: 1) the fact that Alaska has the largest geographic area and lowest population density of all 50 states, 2) the remoteness and isolation of Alaskan villages, 3) the relative poverty and unemployment of the native populations - Eskimos, Indians and Aleuts - comprising one-fifth of the total state population, 4) the need for improved communications, education and teacher training.

For these reasons, and in spite of the relatively low population involved,* a great deal of attention has been paid to development of satellite communications for education and health services in Alaska. The ATS-1 Alaskan teacher training project was described in Section IIC4. The ATS-6 HET experiment will involve transmission of 3 1/2 hours of weekly programs beamed to elementary students in 19 communities, 16 of them rural. Programs will emphasize health education and sanitation, early childhood education, drug education, and English as a second language.(145) For further information on the potential of telecommunications and educational technology to satisfy the educational communications needs of Alaska, the reader is referred to an extensive study by Teleconsult, Inc.(221)

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*Alaska's 1970 Census population was 302,173, or 0.15% of the U.S. population. (221)

10. Other Regions

Although the three regions discussed above have figured prominently in satellite experiments to date, there are indications of additional activity. A region which in some sense parallels Alaska in terms of being made for satellite technology is the Pacific Rim area. Activity using the ATS-1 satellite centered at the University of Hawaii and primarily at the higher education level has been described in Section IIC4. The CTS satellite scheduled for launch in 1975 will involve a number of other states. Included are an extensive facsimile interconnection centered in New York, and a higher education resource sharing experiment involving Stanford University and Carleton College.

11. Conclusion

In this section, we have attempted to identify culturally diverse groups and geographically distinct regions which have their own specific conditions which relate to development of educational telecommunications. It is clear that a large-scale educational telecommunications system must take the kind of cultural diversity that exists in the United States into account if it is to gain acceptance and to allow for meaningful minority group participation. It is also clear that geography and the degree of rural isolation play important roles in seeking to define and initiate satellite-based educational telecommunications experiments.

J. EDUCATION FOR THE AGED AND INSTITUTIONALIZED

1. Introduction

In this section, primary attention is directed at needs and opportunities for telecommunications utilization by older American citizens and by individuals in institutional settings other than those normally thought of as educational institutions. First, the situation and needs of the older segment of the population is examined. The use of nursing homes as possible delivery points for educational programming is discussed.

Several corrective institutions have ongoing programs with community colleges in which televised programs are brought into prisons as part of educational efforts. These institutions are also examined in this section.

2. Education for the Aged

a) Overview - A Demographic Portrait

The American vernacular reserves the term "senior citizen" for those individuals 65 years of age and older. Senior citizens are a demographic growth group in contemporary America; as of July 1, 1971, preliminary U.S. Census Bureau data indicated 20 and 1/2 million Americans (20,555,000) within that age range.(222) This amounted to almost 10% of the total population and approximately 15% of the total adult population aged 18 and over.* During the past decade, and into the first year of the 1970's, this group grew at an annual rate of nearly 2 percent.(222) It is anticipated that there will be more than 25 million senior citizens by 1985.(223)

Statistically, a senior citizen is more likely to be female, white, and...if a male..:more likely to be married.(222) As of 1970, there were about 11 million women and 8 million older men in this category; this female-to-male ratio increases as individuals age, reflecting the shorter life expectancy for men.(223) Most senior citizens are concentrated between ages 65 and 75. Fully one-third of the senior citizens are under 70, and one-half of them are less than 75. At the other end of the scale, there are approximately one and one-half million Americans age 85 and over.(223)

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*The percentage of the adult population is figured according to 1970 population figures.

The life-style of older Americans will depend upon the same constraints molding the habits of any age group, namely income, health, education, mobility, etc. Generally, older people are not an affluent group, spending disproportionately more of their money on the basic necessities of health care, food, and housing. It has come to be widely recognized that many people enter poverty or near poverty upon reaching old age. Total income accruing to older Americans is approximately 60 billion annually. The most prevalent source of income is retirement or welfare benefits, accounting for 52% of the elderly's incoming funds. 29% of their income stems from employment; approximately 20% derives from investments or contributions.(223) An introduction to the U.S. Senate Special Committee on Aging report entitled Developments in Aging: 1971 and January-March 1972 noted, "Almost 5 million or over a quarter of the elderly live below the official poverty line: every fifth poor person in the United States is aged 65 or over."(223)

Health, and health related matters, are generally considered to involve this group a great deal. Although only 14% of the elderly have no health problem of any kind, most of the remaining elderly are still able to manage on their own. Developments in Aging: 1971 noted that 81% of older Americans can get by by themselves.(223)

Scholastically, senior citizens represent an earlier era when this society did not place a premium on education. Statistically, this translates into nearly 3 million functionally illiterate senior citizens and the nearly 50% who did not finish grade school. Conversely, only little better than 6% are college graduates.(233) Nor are the aged the most prevalent group in adult education activities. Data from 1967-1970 indicate that aged students comprised a steady 2-4% of the enrollment in adult basic education classes which usually are held in schools or institutional settings.(14) During 1969, adult education enrolled 295,000 students age 65 and over out of a total enrollment of 13-plus million. Most of these enrollees were white women who participated most often through community organizations. This pattern was maintained by white and negro men and negro women. Other popular means of participating included schools, tutors, and for blacks, part-time attendance at colleges and universities.(119) (See Table 20.)

In a time of seeming nomadic mobility within the general population, only 1.7 million older Americans, or 8.6%, moved during the year March, 1969 - March, 1970. Of that total, only 1% represented residential moves across state lines. However, fully 57% of the senior citizens voted in the 1970 mid-term elections. This represents 17% of all votes cast.(223)

b) Geographic Distribution

The geographic living patterns of older Americans generally conform to that of the population as a whole; senior citizens are in every state and the ten most populous states have the largest numbers of older residents. (See Figure 27 .) Of the ten "megastates," Florida deserves special attention since 21% of its adult population as of 1970, or 14.5% of its total population, was composed of this demographic group.(222, 223)

TABLE 20.—Instructional sources utilized by senior citizens for adult education as percent of age groups, by sex and race: United States, May, 1969

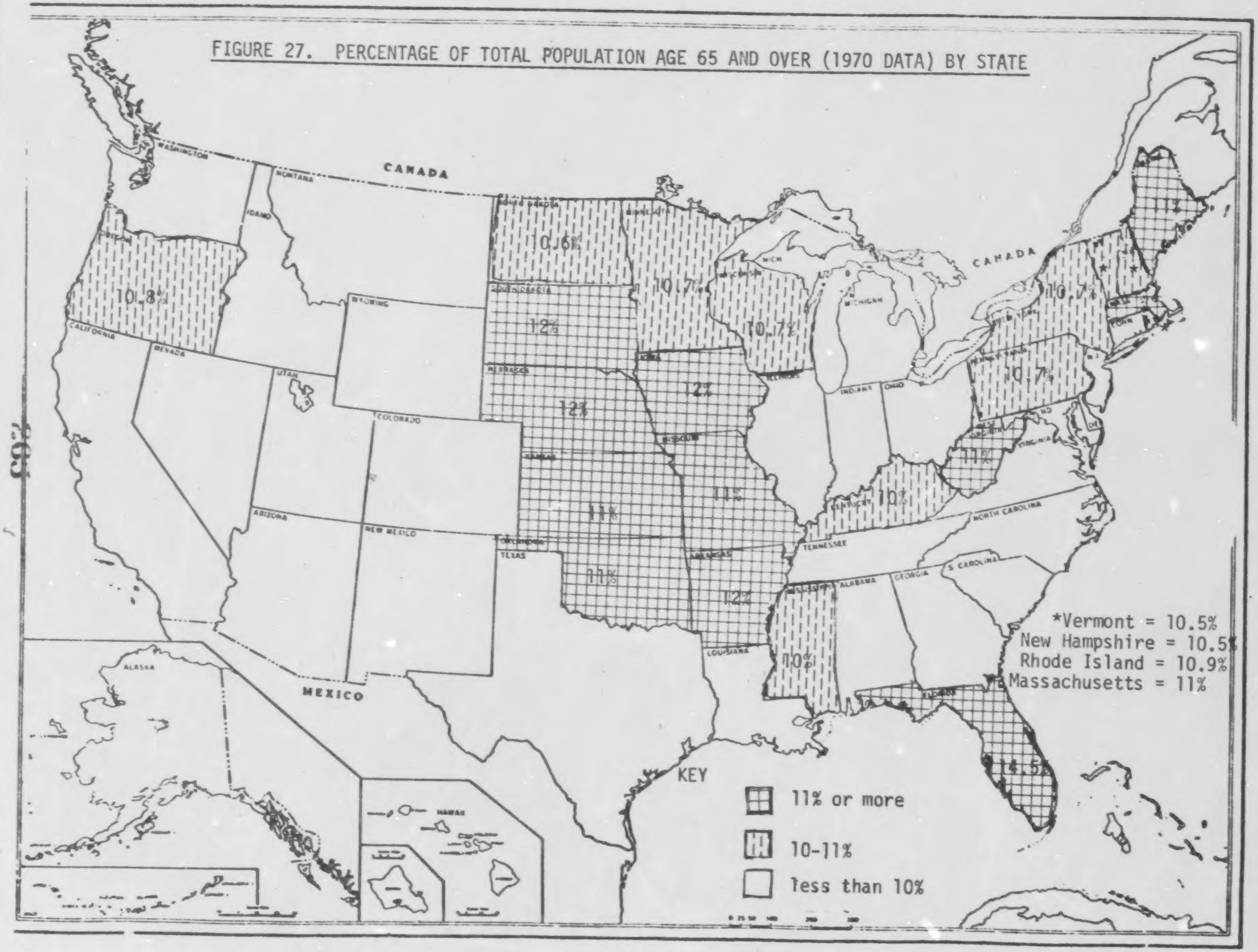
Instructional sources	Total	Men			Women		
		White	Negro	Other	White	Negro	Other
1	2	3	4	5	6	7	8
	i. PARTICIPANTS AGE 65 AND OVER						
All sources (in thousands)	295	98	8	-	180	8	1
	Percent 1/ of column totals						
Public or private school	21.7	23.5	50.0	-	20.0	12.5	100.0
College or university part time	5.4	4.1	25.0	-	5.6	12.5	-
Job training	6.1	10.2	-	-	4.4	-	-
Correspondence courses	6.8	11.2	-	-	5.0	-	-
Community organizations	42.4	23.5	50.0	-	51.1	62.5	100.0
Tutor or private instructor	13.2	14.3	-	-	13.3	12.5	-
Other	13.2	20.4	-	-	10.0	12.5	-

1/ Percentages total more than 100.0 due to participation in more than one instructional source of adult education.

Note: Detail may not add to total because of rounding.

From: Participation in Adult Education, Initial Report, 1969, NCES, OE, DHEW, USGPO: D.C. (1971) by Imogene E. Ames.

FIGURE 27. PERCENTAGE OF TOTAL POPULATION AGE 65 AND OVER (1970 DATA) BY STATE


CANADA
WASHINGTON
MONTANA
IDAHO
OREGON
10.8%
CALIFORNIA
NEVADA
UTAH
WYOMING
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
10.6%
SOUTH DAKOTA
12%
NEBRASKA
12%
KANSAS
11%
OKLAHOMA
TEXAS
11%
MINNESOTA
10.7%
IOWA
12%
MISSOURI
11%
ARKANSAS
12%
LOUISIANA
WISCONSIN
10.7%
MICH
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
10%
TENNESSEE
MISSISSIPPI
10%
ALABAMA
GEORGIA
FLORIDA
14.5%
S CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
11%
PENNSYLVANIA
10.7%
NEW YORK
10.7%
MAINE
11%
CONN
MASS
MD
DEL
CANADA
MEXICO
ALASKA
HAWAII
KEY
11% or more
10-11%
less than 10%

*Vermont = 10.5%
New Hampshire = 10.5%
Rhode Island = 10.9%
Massachusetts = 11%

Data from the 1970 Census reveals that senior citizens apparently like to follow the sun; Nevada, New Mexico, Hawaii, Arizona, and...of course... Florida experienced the biggest percentage growth, one-third or better, in senior residents.(223)* Using the index of a minimum of 11% of a state's total population composed of older residents, senior Americans tend to be contiguously concentrated in midwestern states, New England, and Florida.(223)

Another dimension of the geography of the aged lies in the urban - rural split. 1970 figures, using 20,065,502 as the population base, reveal that slightly more than two-thirds (14,631,115) of senior citizens live in an urban environment. Most of those individuals reside in metropolitan centers (11,105,828), with a 2 and 1/2 million differential in favor the center city over the urban fringe. Another 3 and 1/2 million elderly live in small towns; this total is almost evenly divided between settings of 2,500-10,000 and 10,000 on up.(224) The remaining 5,434,387 live in a rural environment. Slightly more than 900,000 live in hamlets of 1,000-2,000; the vast majority, 4,531,722, live in areas designated "other rural"... presumably farms or villages.(224)

c) Living Arrangements

In broad terms, the aged conform to the living patterns of the general population; individual or family residences and "sharing" quarters with non-relatives are the predominant habitation arrangements. As of 1970, one-twentieth of the older population was institutionalized. 70% of the elderly live as part of a family unit. Should this unit be headed by a senior citizen, there is an even chance that family income will be less than $5,053. The nuclear family arrangement is far more common among older men than older women; approximately 66% of the older men live with their wives as opposed to 33% of the older women who live with their husbands. Roughly 25% of the elderly live by themselves or share premises with non-relatives. This arrangement is more prevalent among older women than older men by 3 to 1. The median income for senior citizens living in this fashion was $1,951 as of 1970.(223) A "communal" living pattern of the elderly, the nursing home, is of interest.

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*It may be hypothesized that the more affluent elderly account for this pattern.

(i) Nursing Homes

Moving into the center of controversy have been nursing homes, which have alternately been branded living graveyards or delightful rest havens.(223) The 1972 Statistical Abstract cites 18,910 homes in the U.S. during 1969. Added to the nearly 19,000 figure are the 4,277 extended care facilities listed by the Statistical Abstract as of 1971, yielding a similar total to that cited by the Senate Special Committee report on aging published in 1972. The distinction between "nursing and related care homes" and "extended care facilities" may be a matter of semantics.* Figures 28 and 29 present statistics on the number of nursing homes, patients and personnel by state.

The nearly 19,000 homes had a total capacity of 943,876 and served 849,775 resident patients. The homes employed 443,572 full-time personnel, although Developments in Aging noted that more than 500,000 people were employed by the nursing home industry and most of them were unskilled.(222, 223) A ratio of 522 personnel to each 1,000 patients was derived from the nationwide totals.(222) How that proportion is interpreted may be a matter of debate; both Developments in Aging and Old Age: The Last Segregation,(226)

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*See Developments in Aging, 1969, 1971, and Old Age: The Last Segregation.(222, 223)

FIGURE 28. NUMBER OF NURSING HOMES (1969) AND EXTENDED CARE FACILITIES (1971), BY STATE

Note: Top figure represents Nursing Homes, bottom figure represents E.C.F.s,
* represents figures listed at bottom.

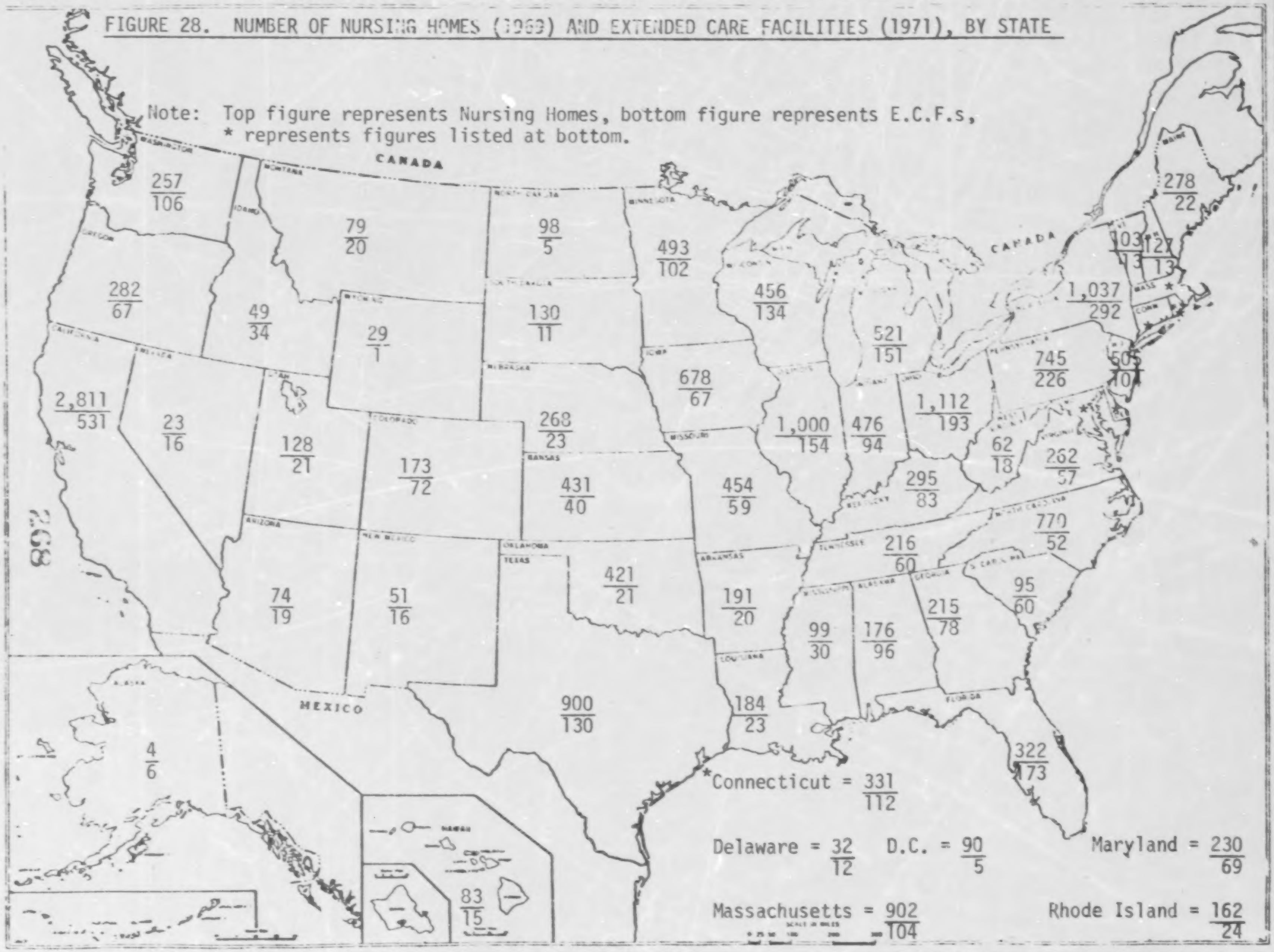
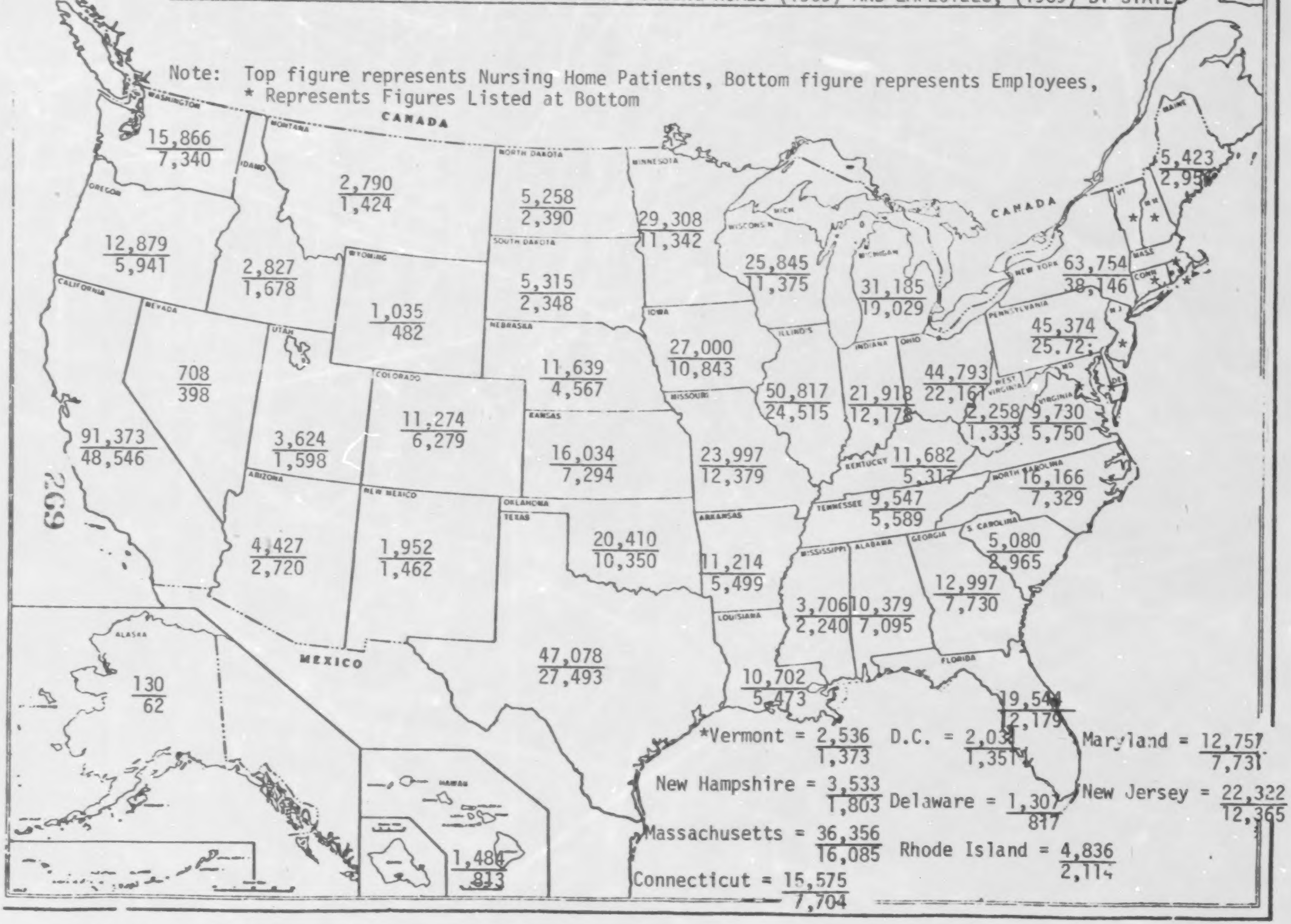

CANADA
257/106
79/20
98/5
493/102
456/134
521/151
278/22
103/13
127/13
1,037/292
282/67
49/34
29/1
130/11
678/67
745/226
505/101
2,811/531
23/16
128/21
173/72
268/23
431/40
1,000/154
476/94
1,112/193
62/18
262/57
454/59
295/83
770/52
216/60
95/60
421/21
191/20
99/30
176/96
215/78
74/19
51/16
900/130
184/23
322/173
4/6
83/15
MEXICO
*Connecticut = 331/112
Delaware = 32/12
D.C. = 90/5
Maryland = 230/69
Massachusetts = 902/104
Rhode Island = 162/24

FIGURE 29. NUMBER OF RESIDENT PATIENTS IN NURSING HOMES (1969) AND EMPLOYEES, (1969) BY STATE

Note: Top figure represents Nursing Home Patients, Bottom figure represents Employees,
* Represents Figures Listed at Bottom


CANADA
WASHINGTON
15,866
7,340
OREGON
12,879
5,941
CALIFORNIA
91,373
48,546
IDAHO
2,827
1,678
NEVADA
708
398
MONTANA
2,790
1,424
WYOMING
1,035
482
UTAH
3,624
1,598
ARIZONA
4,427
2,720
COLORADO
11,274
6,279
NEW MEXICO
1,952
1,462
NORTH DAKOTA
5,258
2,390
SOUTH DAKOTA
5,315
2,348
NEBRASKA
11,639
4,567
KANSAS
16,034
7,294
OKLAHOMA
20,410
10,350
TEXAS
47,078
27,493
MINNESOTA
29,308
11,342
IOWA
27,000
10,843
MISSOURI
23,997
12,379
ARKANSAS
11,214
5,499
LOUISIANA
10,702
5,473
WISCONSIN
25,845
11,375
MICH
ILLINOIS
50,817
24,515
MICHIGAN
31,185
19,029
INDIANA
21,918
12,178
OHIO
44,793
22,161
KENTUCKY
11,682
5,317
TENNESSEE
9,547
5,589
MISSISSIPPI
3,706
2,240
ALABAMA
10,379
7,095
GEORGIA
12,997
7,730
FLORIDA
19,54
12,179
S CAROLINA
5,080
2,965
NORTH CAROLINA
16,166
7,329
VIRGINIA
9,730
5,750
WEST VIRGINIA
2,258
1,333
MD
DE
PENNSYLVANIA
45,374
25.72
NEW YORK
63,754
38,146
N J
CONN
MASS
VT
NH
MAINE
5,423
2,95
CANADA
MEXICO
ALASKA
130
62
HAWAII
1,484
813

*Vermont = 2,536 / 1,373
New Hampshire = 3,533 / 1,803
Massachusetts = 36,356 / 16,085
Connecticut = 15,575 / 7,704
D.C. = 2,03 / 1,351
Delaware = 1,307 / 817
Rhode Island = 4,836 / 2,114
Maryland = 12,757 / 7,731
New Jersey = 22,322 / 12,365

a report from a Ralph Nader study group on nursing homes, write of poor care and facilities, inadequate help, and untrained personnel. The 1971 total of 4,277 extended care facilities had a nation-wide capacity of 306,998 skilled nursing beds; this fact, plus the definition given by the Statistical Abstract which notes the transfer agreements between hospitals and extended care facilities, indicates that at least in theory extended care facilities care for sicker people or those involved in an extended recuperation.(222)

The impetus for growth in the nursing care industry and increased utilization of facilities stems in large part from third-party payment plans that will cover most expenses. Federal government contributions, which account for three-fourths of the industry revenues, are channeled through Medicare and Medicaid. The Medicaid reimbursement system (and presumably Medicare too) repays providers a flat per diem rate for each bedridden patient and reduces this amount when the patient becomes ambulatory. Developments in Aging: 1971 and January-March, 1972 gave the maximum rate as $14 per day, which is considered by many too low for full recompensation. In any event, the payment system is said to provide incentive for minimal care whether the provider maximizes profits or keeps costs in line. The same report recommended that the incentive system be revised to provide escalating payments contingent upon quality of care.(223)

Finally, it should be noted that the 1971 White House Conference on Aging focussed upon the minorities under-served by existing nursing home facilities. Included were Blacks, Orientals, and Indians. Hispanic elderly preferred living within the extended family unit to institutionalization; therefore, home health supportive services were particularly relevant to their needs.(223)

(ii) Chronic Hospitals

Yet another component of the institutionalized population is the number count of those in chronic, or long-term, hospitals. The 1972 Statistical Abstract lists figures for mental hospitals (and residential treatment centers), tuberculosis hospitals, and chronic hospitals providing extended care for those with other long-term illnesses. The data reflects 1960 figures, and does not provide an age break-down of the gross statistics. However, it may be that a fair percentage of the total number represents the infirm elderly. The gross figures are: 1) mental institutions, 630,000 total, 336,000 men and 294,000 women; 2) TB hospitals, 65,000 total, 46,000 men and 19,000 women; 3) chronic disease hospitals, 42,000 total, 25,000 men and 17,000 women.(222)

d) Organizational Constructs

(i) Governmental

As with many other demographic sub-groups, there are agencies embedded within the federal and state governments to serve the needs of the aged population. A cursory overview indicates that responsibility is divided among an assortment of departments and branches, at least on the national level, with each organization catering to the needs of the elderly as they pertain to the overall responsibility of that agency.

Within the Department of Health, Education, and Welfare there is the Administration on Aging lodged within the Social and Rehabilitation Service. Also within that department is the new (as of 1972) Office of Nursing Home Affairs to coordinate efforts to enforce minimum standards on the industry.

Additionally, there is the Social Security Administration, which not only oversees transfer payments but also operates the Medicare and Medicaid programs. Within the legislative branch is the Senate Special Committee on Aging to monitor government activities in this field.(223) As of March, 1972, the Department of Housing and Urban Development created the post of Assistant to the Secretary for programs for the handicapped and the elderly.

(ii) Private

The aged operate as any other "special interest group" within our society, namely, they have their own organizations reflective of their interests. The American Association of Retired Persons has a broadly-based membership of 4,000,000. Association activities include sponsorship of travel tours, consultancies with church, business, and industrial groups on retirement adjustment and preparation, maintenance of a nursing home, offering medical, life, and automobile insurance, and an adult education program. The AARP sponsors the Institute of Lifetime Learning, operating from both Washington, D.C. and Long Beach, Calif., and is affiliated with the Retired Teachers Association and the International Association of Retired Persons. A bi-monthly magazine entitled Modern Maturity is published by the Association.(225)

There is also the National Health and Welfare Retirement Association which runs the pension funds for the employees of over 4,000 non-profit charitable organizations.(225) This brings to mind the organizations that must surely be maintained by other large entities such as unions, national corporations, etc., to operate pension funds and provide concommitant services for retired workers.

There are countless informal or quasi-formal constructs for outreach to the aged. Church and other community groups operate programs to involve the elderly; these may take the form of providing service in the home (the "meals on wheels" projects) or by forming activities or interest groups composed of older members. Here again one might hypothesize that the range of outreach efforts and interest groups available to the elderly are greater in urban areas where distance is not inhibiting and where more services tend to be concentrated. Yet another hypothesis is that those aged individuals who were not part of an organized occupational group during their working lives might also lack participatory opportunities during retirement, since there appears to be some carry-over between the individual's working role and his retirement opportunities. Therefore, two types of elderly individual may well be "under served;" those who live in remote areas and those who become wholly dependent upon personal resources (family, friends, acquaintances) without access to any group based upon their age-group interests.

e) Use of Technology and Telecommunications

Most of the aged live as part of the total society, presumably with access to the most prevalent large-scale electronic media, the telephone, television, and radio already in their homes. Therefore, public broadcasting, for example, might be able to make significant contributions in this sector. A CPB advisory task force is currently studying the future role of CPB vis-a-vis adult education. It is not known to what extent the needs of senior citizens are being emphasized.

It may be necessary to pay special attention to the needs of senior citizens in technology-based adult education programs. The experience of the "RFD" multimedia program geared towards rural audiences (see Section IIE) may be an indication of two things: 1) when adult education programs go directly into the home this audience can be attracted, and 2) the format was non-didactic with a strong "country" flavor, the latter particularly hypothesized to be attractive to this demographic group. As the demographic composition of the elderly changes, e.g., as more educated adults achieve senior citizen status, there may be an increased demand for this type of service.

It should not be assumed that the advent of cable programming and services would automatically become another means of reaching this audience. The additional cost to the consumer for CATV coverage may be beyond the budget of a good portion of this target group. The more affluent elderly, who may be living in concentrated retirement communities, e.g., condominiums, could possibly form a segment of the potential CATV audience for specialized services and programming. As any new large-scale technology decreases in cost and assumes greater penetration, assuming the economics of the technology permit economies of scale, the outlook may change, and a greater proportion of the aged may be included in the potential audience.

The institutionalized aged, especially those in nursing homes, ideally would be a different story. In such situations, there is a concentration of the target audience, on-site personnel to provide follow-up, and the possibility that special equipment such as wiring for cable television, SCA-FM, etc. might be affordable. However, whether in fact this will come to pass, given the condition of some nursing homes described previously, remains to be seen.

The type of programming for the aged becomes an issue worthy of more consideration. Since senior citizens overwhelmingly live as one sub-group among many within the total society, how can one tell if they are being neglected by existing commercial and educational broadcasting outlets? In other words, what kind of programs would be specifically tailored to their interests?* Possible examples include consumer topics, health matters and available resources, and information on community groups and activities. Emphasis might be on informing the elderly of what is going on around them and involving them in pertinent interest groups and resources. In effect, programming might be an extension of public services. Should programming be designed with an involvement component, e.g., a home visitor, or predicated upon participation in a relevant community group, the effectiveness may be enhanced.

While noting all of these possibilities, which are not unique to this section of the report, steps should be taken so as not to unintentionally segregate the elderly. They live in a youth-oriented society and may feel estranged from the contemporary mainstream. In the event that programming reinforces this by making an elaborate point of their senior status, such efforts may be self-defeating.

Formalized adult education has apparently had little success to date in attracting elderly students. Whether this is due to lack of interest or to the fact that such activities have largely been centered in institutions (schools and colleges) remains hypothetical. However, much that is currently available on educational stations of an avocational nature may be of interest to the elderly as well as other hobbyists within the general viewing public.

There are opportunities for CATV and radio, especially FM sub-carrier bands, to serve professionals and paraprofessionals who serve the elderly, in much the same way that increased channel capacity would aid specialists in any field. Literature notes the untrained and unskilled status of many nursing home employees. Coursework from post-secondary institutions offering relevant programs could be provided on-the-job or at home. Incentive for this may come should nursing home regulation become stricter. Professionals serving the elderly, such as physicians and social workers, could use the technology to keep abreast of developments in their respective fields. In the field of telemedicine particularly, new opportunities are offered.(227) Literature notes the dearth of available physician services within nursing homes; interactive cable links between establishments and medical centers or satellite clinics may be tried in the hope of expanding the coverage of the professional service providers.

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*Specific demographic programming data has not been investigated.

3. Education for the Incarcerated

a) Introduction

Correctional facilities have attained more visibility in recent years prompting an upswing in public discussion of prisons and prison life. One aspect to be investigated more fully in this section is the possibility of using the period of incarceration for educational purposes. General characteristics of the prison population, social pressure to use the time for constructive rehabilitation, and widely-held societal beliefs linking educational and economic disadvantage with criminal behavior, have combined to promote greater concern for and implementation of educational programs behind prison walls.

Of the democratic industrialized nations, the United States has proportionately more people incarcerated (per 100,000 population) than any other,(228) in a three-tiered prison system corresponding to each level of government. In large part due to the heterogeneity of prison control, the incarcerated population is not a homogeneous audience for educational purposes. Primary needs and corresponding emphasis is upon remedial or equivalency education and vocational training. However, some prison inmates are earning college degrees with the aid of educational television programs.

b) A Portrait of the Prison Population

(i) Statistics

During 1971 there were approximately 21,000 inmates in federal correctional institutions.(229) As of March 15, 1970 there were 160,863 inmates in local jails.(230) The number of individuals in state correctional facilities is unavailable; National Prisoner Statistics, State Prisoners, 1970, the most recent source, failed to present nation-wide totals on state institution inmates due to lack of data from 17 states.(231)

However, it may be deduced that most inmates of correctional institutions are at the state and local levels. The federal prison's Education and Training Annual Report, CY 1971, noted that federal prisons accommodate approximately 5% of the national prisoner population.(229) Taggart notes that during 1967, 175,300 people were in state facilities while 19,600 were in federal prisons.(228)

There are other means of accommodating the offender population. Probation, parole, half-way houses, detention homes, and juvenile centers are examples. Evidence indicates that most offenders are on parole and probation, thus part of the total community; figures for 1966, cited by Taggart, reveal 62,000 institutionalized juveniles compared to 283,000 on parole or probation, while there were 343,000 institutionalized adults compared to 534,000 on parole or probation.(228) Additional statistics from 1966, again quoting Taggart, indicate approximately 13,000 offenders in detention homes while there was in excess of 50,000 individuals in juvenile institutions.(228) Table 21 presents data on the age, race, and sex of all prisoners as of 1960.

(ii) Characteristics of Correctional Facilities

Each tier of correctional facilities has its own characteristics, making it more or less amenable for being a potential delivery point for electronic instruction. For instance, Taggart characterizes juvenile facilities as offering a broader array of professional services for inmates resulting in a higher per-inmate cost. In 1965, the average per-capita cost for juvenile institutions was $3,411; this amount was more than treble the average per-capita cost in local facilities and almost double the cost for state institutions.(228)

Local correctional facilities are characterized by a proportionately large transient population, meager facilities and few services, often overcrowded conditions, and low per-capita cost mentioned previously. Of the 160,863 individuals comprising the local jail population as of March, 1970, one out of 20 was female, and 7,800 were juveniles. 69,096, or 43%, were serving out sentences of various durations; a simple majority of 52%, or 83,079, "were pre-trial detainees or otherwise not convicted." The remaining 5%, or 8,688, were waiting post-trial continued legal action.(230) Taggart notes that most of those serving time had sentences of one year or less.(228) Interestingly, only 5% of all local facilities were reported to be overcrowded; however, crowded conditions predominated in the larger institutions. 10% of the facilities designed for 100-299 inmates are overcrowded, some by as much as their original capacity. 30% of the facilities designed for 300 or more prisoners are overcrowded. 14 such institutions, all located in large metropolitan areas, were overcrowded

TABLE 21.—Average Population in Correctional Institutions, 1960

	Total	*Federal and State Prisons and Reformatories*	*Local Jails and Work Houses*
		All Races	
All ages	349,298	229,306	119,992
Male	332,952	220,765	112,187
Female	16,346	8,541	7,805
Under 15	736	137	599
15-19	32,379	19,815	12,564
20-24	65,906	44,803	21,103
25-39	156,236	108,093	48,143
40-59	82,955	50,123	32,832
60 and over	11,086	6,335	4,751
		Nonwhites	
All ages	133,249	87,401	45,848
Under 15	324	68	256
15-19	11,197	6,639	4,558
20-24	24,019	15,242	8,777
25-39	67,469	45,582	21,887
40-59	27,644	18,200	9,444
60 and over	2,596	1,670	926

SOURCE: U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population: 1960*, Series PC (2)-8A.

Source: Robert Taggart III, The Prison of Unemployment. Manpower Programs for Offenders Baltimore: The Johns Hopkins University Press, 1972.

by more than 300 individuals.(230) Counting only those facilities located in cities of at least 25,000 or which are county-run (3,319), 90% fail to provide any educational resources. 86% of the same institutions failed to provide any recreational facilities, and slightly less than half failed to provide any medical resources.(230)

Due to the paucity of data regarding state correctional facilities, a composite picture of these institutions is difficult to draw. It is assumed that a good portion of any educational effort for the incarcerated would take place within such facilities, largely because of their comparatively sizeable inmate population and (presumably) "better" facilities. The stability of the state inmate populations is ambiguous, since offenses may demand different sentences in different states.(231) However, Taggart has noted for 1967 that the turnover rate for both state and federal prisons was approximately 2/5 of the total inmate population.(228)

Federal correctional facilities are 26 in number, scattered across the country (Figure 30). These institutions serve a population that is educationally deficient, 15% functionally illiterate upon admission, 90% without a high school diploma, and approximately 80% without a marketable skill.(229) For this reason, and because of a desire to reduce recidivism, the federal correctional system is committed to a program of education for its inmates. As of December 31, 1971, the federal prison system maintained an education and training staff of 428,* of whom 285 were employed directly in instruction. Educational activities are carried out at all 26 centers, and instructional equipment is in use. Libraries at each facility are now "learning materials centers," where individual carrels have been constructed and programmed instruction is encouraged. Electronic

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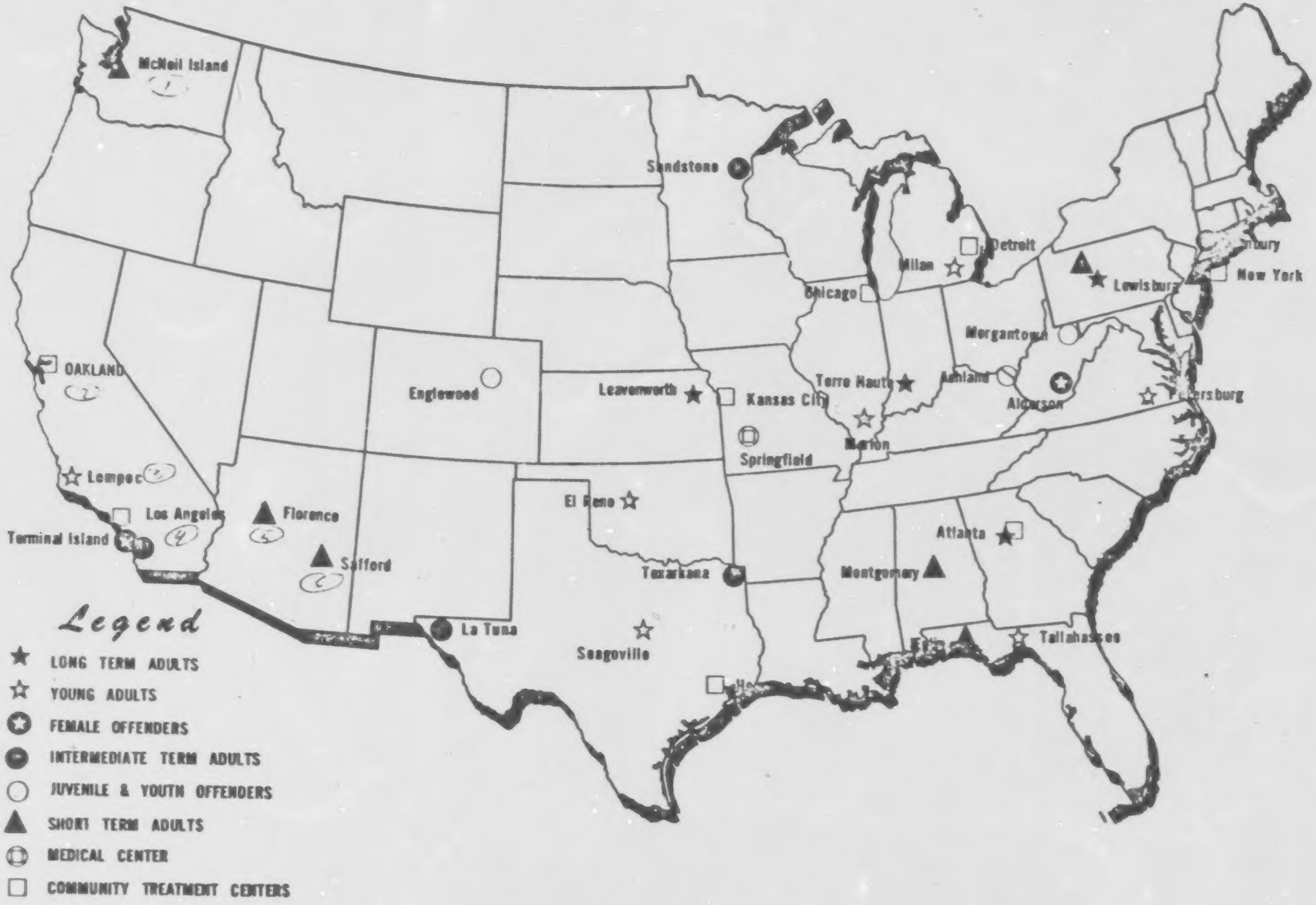
*The educational staff figure had risen slightly to 438 by June 30, 1972.(233)

FIGURE 30

FEDERAL CORRECTIONAL SYSTEM


McNeil Island
1
OAKLAND
2
Lompoc
3
Los Angeles
4
Terminal Island
Florence
5
Safford
6
La Tuna
Englewood
Sandstone
Leavenworth
Kansas City
Springfield
El Reno
Texarkana
Seagoville
Ho
Chicago
Milan
Detroit
Terre Haute
Marion
Ashland
Morgantown
Alderson
Lewisburg
bury
New York
Petersburg
Atlanta
Montgomery
Tallahassee
Legend
★ LONG TERM ADULTS
☆ YOUNG ADULTS
FEMALE OFFENDERS
● INTERMEDIATE TERM ADULTS
○ JUVENILE & YOUTH OFFENDERS
▲ SHORT TERM ADULTS
MEDICAL CENTER
☐ COMMUNITY TREATMENT CENTERS

Source: Education and Training of Incarcerated Federal Offenders, Annual Report, CY 1971. Bureau of Prisons, U.S. Department of Justice equipment is in use, including computers and videotape record and playback machines; how widespread this is remains oblique (e.g., "... and most facilities are supplied with video recording and playback equipment.")(229) During calendar year 1971, $6,500,000 was spent for education within the federal corrections system, of which 80% went for salaries. In addition to that amount, $420,000 was spent for machinery and equipment.(229) The educational program was supported by revenue from Federal Prison Industries, Inc. (50%), Congressional appropriations (47%), and other governmental sources (3%) usually for specific projects of limited duration, e.g., such as funds from the Manpower Development and Training Act or the Office of Economic Opportunity.(229) By FY 1972, expenditures had risen to $3.5 million for vocational training and $3.6 million appropriated for education.(233)

c) Federal Funding for Programs

Although writing specifically of manpower programs, Taggart notes an increase in both amount of money and funding sources for programs designed to reduce employment problems of offenders, ex-offenders, parolees, probationers, etc. The point is that amounts cited by Taggart might swell the amount previously cited regarding expenditures for in-prison education and training efforts. Spearheaded by the Department of Labor, the Bureau of Prisons, the Social and Rehabilitation Service, the Law Enforcement Assistance Administration (LEAA), the District of Columbia Department of Corrections, and the National Institute of Mental Health have all funded research and operational programs.(228)

Writing in 1972, Taggart recounts the recent funding history of federal agency efforts involving offenders:(228) during FY 1970, $6.2 million was spent by the Department of Labor; projected spending for FY 1972 totalled

$29.4 million. Of that projected total, $10 million was anticipated as "seed money" to be matched by the states for vocational training in prisons. Taggart also refers to the fact that many of the special projects had other (than vocational training) primary emphasis, such as the Bureau of Prisons investigation of adult basic education.

It is difficult to determine the funding course beyond FY 1972 for these programs. Within the Department of Justice, aggregate federal funding for the federal prison system rose approximately $40,000 for FY 1973 to estimated outlays of $167,566,000; expenditures anticipated in the FY 1974 federal budget are for $184,471,000, an increase of $16,905. Within the aggregate federal prison budget, ceilings for vocational spending have been rising since FY 1972; the FY 1974 budget shows an expected increase of $731,000, to $5,600,000. Only gross spending for the Law Enforcement Assistance Administration is available. Within the Department of Labor, the proposed disbursal mechanism for manpower funds is manpower revenue sharing; although rather dramatic decreases are shown for this by the FY 1974 budget (-$252,000,000), it is possible that funds on a level similar, or slightly higher, than FY 1973 would continue to be spent but allocated through other channels. For instance, the trust fund for manpower training and employment services should increase from $28,923,000 to $398,222,000 during FY 1974.(232)

d) Educational Activities of Correctional Facilities

Based upon the characteristics previously provided for each tier of the correctional system, it is a "safe guess" that the main delivery points for education and training efforts will fall upon the federal and state systems.

(i) Educational Efforts in State Facilities

An upswing in educational and training efforts in state correctional facilities was spearheaded by federal money when in 1966 the Manpower Development and Training Act was amended by Section 251, enabling the Secretary of Labor to implement MDTA projects on an expanded scale in prisons. The authority was granted through June 30, 1970, and was not extended after that time. More than fifty "251 Projects" were initiated, of which an estimated 55 remained operational by 1972. Some of the projects continued to receive federal monies, but most were reported operating from state matching funds. The remaining 55 projects were serving an inmate population of 5,000. The projects were conceived and implemented so that in addition to vocational training, many "students" received remedial education, counseling, and employment counseling. Follow-up on 25 of these projects indicated that vocational training had little-to-marginal effect on post-release employability and recidivism. Basic education received, however, was found to be a helpful variable; "students" themselves rated this as the most helpful part of the project.(228) Of interest here is that most of the "251 Projects" were apparently conducted in state prisons. Of the 25 projects studied longitudinally, representing 30 institutional settings, 2,877 inmates were served. Only 184 of the student population were not in state prisons; institutions represented were concentrated in the South.(228)

Taggart notes that the state prison population has about the same educational deficiencies as the federal prison population. Generally, it appears that remedial educational services are more frequently offered in state prisons, but they usually do not reach a good proportion of the potential audience. Taggart describes the situation thusly:(228)

> "Among the state prisons with MDTA programs in 1968-69, only 3% provided no basic education courses on their own; but in a fifth, less than 5% of the inmates participated; and in a third, only between 6% and 20% benefitted. High school equivalency (GED) courses were less frequent, with a fifth of the prisons having no such program, and only a third serving more than 10% of their inmates."

Traditionally, prison education programs have been understaffed, poorly financed, and outmoded. This situation has evidently changed somewhat over the past few years, primarily with the advent of programmed learning which encourages individual pacing. Taggart notes that in conjunction with programmed learning "...frequent use is made of audio and visual equipment."(228)

Since there is some evidence that the component of critical value to a released offender is remedial education (as opposed to straight vocational training), Taggart comments, "Education programs in prison can have a positive impact on the future work success of participants; and the more intensive the programs, the more favorable the impact will probably be."(228)

(ii) Educational Efforts in Federal Facilities

The federal corrections system is committed during this decade to the following three goals for each released offender: 1) "[Each] will have achieved a sixth grade reading ability as a minimum," 2) "[Each] will have successfully completed the GED, if of average intelligence and without high school completion or equivalency," 3) "[Each] will possess at least an entry level job skill in a career oriented occupation." Additionally, effort is going into affective skills, such as preparation for release and using leisure time productively.(229)

Literature from calendar year 1971 outlines these salient facts about the conduct of educational services within the federal prison system: 1) an inmate's daily schedule is divided so that 7 hours are available for voluntary activities, which would include remedial education programs, 2) 95% of the instructional activity occurs within the prison setting, although carefully screened prisoners are allowed to participate in off-site education and training programs; 3) each year approximately two-thirds of the inmate population will participate in some education or training program; on the average, 7,000 inmates attend "classes" each day; 4) due to conflicting figures, it is difficult to determine if completions are increasing; decreases appear to be marginal. It is maintained that enrollments are increasing. Nonetheless, completion percentages posted indicate a higher percentage than would be expected for the non-institutionalized public (see Table 22). 5) the average stay in a federal institution is 20 months,(233) 6) of the 26 institutions, 17 contracted with community agencies ranging from colleges to vocational schools to provide suitable instruction, studies, and testing.(229)

Vocational training is provided in 40 areas. Two stipulations are made regarding occupational education: 1) it must be in a skill area that can be provided economically, and 2) much of it corresponds to skills that can be practiced "on the inside," so that on-the-job training can accrue automatically.(229) Of the 40 skill areas in which instruction is offered, 21 are considered "institutional maintenance assignments," while registered apprentice programs are offered in a variety of the skilled trades and crafts ranging from radio and TV repair to tool and die maker.(233)

Remedial education is offered with Adult Basic Education, GED (high school equivalency), and high school courses. College courses may also be offered.(233)

TABLE 22

OFFENDER PARTICIPATION, ACHIEVEMENT, FY 1972

	Enrollments	Completions	% of Compl.	Nr. of Inst. Ofrng
Adult Basic Education	3,598	1,362	37%	25
GED Preparation	3,542	1,788	50%	27
High School courses	2,575	1,437	55%	20
Social Education	2,677	1,881	70%	17
College Training	1,915	1,377	71%	16
Vocational Training	7,862	4,954	63%	27

Source: "Overview of Education and Training for FY 1972," (Mimeo)

The federal system also offers staff training programs and, with Project Newgate, an opportunity for youth offenders to live in a "half-way" house while attending universities in Kentucky, New Mexico, Pennsylvania, Colorado, Oregon, and Minnesota.(234) Staff training centers are maintained by the Bureau of Prisons in El Reno, Oklahoma, Atlanta, Georgia, and Petersburg, Virginia, in which new employees of the system are instructed in offender rehabilitative techniques emphasizing small group interaction. The programs employ a variety of audio-visual methods including closed-circuit television.(235) Internally, educational activities are largely implemented at each institution by the Supervisor of Education. Included within their responsibilities are the daily running of programs within their institution and the choice of learning materials. The Washington, D.C.-based apex of the system is the Central Office headed by the Deputy Associate Commissioner for Education. This office is in turn a division of Federal Prison Industries, Inc. At the Central Office level, policy formation and resource acquisition and allocation is carried out. Additionally, the Central Office acts as a clearinghouse for pertinent educational materials. Distribution includes federal institutions; however, state institutions will be supplied with desired learning materials if quantities permit. As of 1971, expectations were for this channel to develop into a National Clearinghouse for Correctional Education. This would be done in cooperation with the LEAA.(229)

d) Use of Technology and Telecommunications

Apparently one societal sector to benefit from programs initiated under the "Great Society" was the prison population, when efforts were made to invigorate education and training programs offered during incarceration. Due to the paucity of resources and the transient population in local jails, primary delivery points for electronic education would be state and federal correctional institutions. Prior to examining the kind of electronic media most likely to be used, two issues should be discussed. The first is that education for this group is not a panacea rapturously embraced by staff and students alike; Taggart mentions the staff cynicism that accompanied many of the initial efforts in state prison vocational training programs and the negative attitude among prisoners that may prevail regarding education. This is not to "write off" education and training efforts for the inmate population, but to inject "realistic" insights into complications that may occur irrespective of delivery mechanisms.

A quick perusal of a bibliography for correctional education(236) indicates a good amount of interest in programmed instruction. Indeed, this concept of individualized learning reappears in much of the federal system's literature regarding current efforts in correctional education. Whether or not programmed instruction is delivered by electronic means, or to what extent it is delivered in this fashion, remains unclear. However, it may be that computer-aided instruction will prove useful in the future.

There are instances in which televised instruction has proved of value to prisoners. Chicago TV College is reported to have a sizeable enrollment of inmates for its programs, some of whom acquire degrees. Miami-Dade Community College also is reported to have inmate students. The "captive audience" aspect of educational TV viewing in prisons is clearly present. Other institutional or quasi-institutional settings such as nursing homes and apartment complexes for the elderly may have the same characteristic.

The extent of community tie-in with prison educational efforts remains undetermined. Although most correctional education takes place within the institution, a fair amount of assessment and instruction work is done by outside sources "imported" for the occasion. How this "importation" takes place also remains unclear; presumably, outside instructors are brought in for specific courses. An opportunity for closed-circuit television, ITFS, or cablecasting would seem to be present. These media alone will not solve the problems of inadequate equipment for some training programs, but they may provide a means of continually broadening the expertise available to this student population.

The ultimate relevance of any large-scale electronic delivery system will be its cost-effectiveness. How this will be measured has not been elucidated. For instance, a prime goal of any education and training program is to reduce recidivism; will media cost ultimately be compared to the trainee return rate? Clearly, the federal prison system is most cost conscious in providing any education and training service, and may be willing to provide funds for cable hook-up, more data terminals, etc. if this could be done on a shared, or otherwise cost-efficient, basis.

Finally, an infrastructure is apparently developing tying in Washington, D.C. planners, prison principals, and interested state correctional personnel. Access to the information transfer techniques valued by overlapping bureaucracies might well be of interest here.

III. EDUCATIONAL TELECOMMUNICATIONS SERVICES: DEFINITIONS AND UTILIZATION

A. INTRODUCTION

In the previous chapter, a variety of educational subsectors were examined in detail with emphasis upon the existing situation and trends which might influence future technology utilization. Specific instances of technology utilization in each subsector were discussed whenever possible and educational satellite activity was highlighted.

In this chapter, the information and analyses, rather than being specific to particular educational subsectors, are organized around several educational telecommunications services which are believed to have potential for future delivery in a large-scale educational telecommunications system employing communications satellites. Although some of the material in this chapter may overlap with that in the previous chapter, it is believed that an emphasis upon the services as well as the subsectors is desirable in identifying opportunities for satellite utilization.

There are a variety of ways in which educational telecommunications services can be organized. For example, one approach is to classify services in three broad categories:

1. Information Dissemination and Broadcast Services.

This service can be characterized by transfer of information to many terminals from one centralized facility. Messages are originated by human beings in voice, graphic, and pictorial form for immediate consumption by human beings. It is essentially a one-way transfer of information on a point-to-multipoint basis, as found in radio and television broadcasting, and in most existing uses of cable television and the Instructional Television Fixed Service.

2. Interactive Telecommunications Services.

This category can be further broken into two parts: a) systems which involve interaction between two or among several human beings, and b) systems which involve interaction among man and machine. Both categories require two-way transmission circuits. In some cases, channel capacity will be asymmetrical. Systems and/or services such as teleconferencing via picturephone and telephone, talk-back television teaching systems, etc., come under the first category. The second category of services is typified by the systems/services in which a large number of terminals are capable of making an inquiry to a single repository of information which is capable of retrieving the requested information and responding to the inquiry. Examples include on-line information retrieval and computer-assisted instruction.

3. Computer-Communications Services.

This service includes time-sharing in the strictest sense of the term - i.e., the sharing of a computer's time among a group of users, and is closely allied to the inquiry and response described in the interactive services except for the fact that transmission rates are much higher and interaction is not limited by the human capacity. The communication requirements are of the two-way point-to-point type; channels can be symmetrical as well as asymmetrical. Subcategories include remote batch processing, resource sharing, distributed intelligence and time-shared computer services.

Figure 31 graphically depicts possible uses of some educational telecommunications services in various educational subsectors and at different delivery points for general educational applications, namely, instruction, research and administration.

In what follows, first a brief review will be presented of recent studies which center around educational telecommunications services and technology. This will be followed by consideration of five categories of educational telecommunications services which are believed to encompass a broad range of services of interest to educational telecommunications system planners, namely: a) public broadcasting, b) instructional television, c) computer-aided instruction, d) computer resource sharing, and e) information resource sharing. Much of the information to follow is a summary of more extensive studies performed in connection with this research effort.(7, 8, 9, 10, 11, 12)

There are two qualifications to note before proceeding. First, this does not represent a "how-to-do-it," "how-does-it-work" manual of educational telecommunications technology, although information of that kind would certainly be desirable to have available. The major purpose of the information and analyses in this chapter is to aid educational telecommunications planners and designers in identifying opportunities for future educational satellite utilization. Hence, some prior familiarity with the services is desirable.

Second, it should be kept in mind that there are many different kinds of instructional technologies ranging from portable film strip projectors to the ARPA computer network spanning the nation. * In this study, those

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*A recent study by Goldstein examines the "Alternative Television" movement which makes heavy use of low-cost portable videotape equipment. (106)

	Public Television (PTV)	Instructional Television (ITV)	Computer-Assisted Instruction (CAI)	Remote Batch Processing	Interactive Multi-Access Computing	Inter-Library Communication	Interactive Information Retrieval	Teleconferencing
Elementary Schools		[I,C]	[I,C]	[A]	[A,I]		[C]	
Secondary Schools		[I,C]	[I,C]	[A,I]	[A,I]		[C,I]	
Institutions of Higher Education		[I,C]	[I]	[A,I,R]	[A,I,R]	[R]	[C,I,R]	[A,I,R]
Vocational Education		[I]	[I]					
Community Learning Centers	[G]	[C,I]	[C,I]		[C,I]		[C,I]	[C,I]
Homes	[G]	[C]	[C]				[C,G]	[C,G]

A = Administrative Uses
C = Continuing Education and/or Formal out-of-school Education
G = General Information and/or Educational, Cultural Entertainment
I = In-School Instruction
R = Research Applications.

Figure 31: Educational Telecommunication Service Applications

services that might lend themselves to large-scale regional and/or national distribution and networking are given primary attention because satellite technology lends itself primarily to large-scale distribution.

B. TECHNOLOGY FOR EDUCATION: REVIEW OF RECENT STUDIES

Recent reports and articles provide considerable information on what Armsey and Dahl(54) have described as "The Things of Learning." Often, these reports freely mix media (e.g. television and radio) with delivery or transmission systems, (e.g., cables and satellites) with integrated systems of hardware and software (e.g., public television). Although relatively plentiful and of interest to educational technologists and planners, some of these reports often become rapidly outdated due to changes in technology and costs. The brief review presented here highlights comments by the authors of these reports concerning past, present or future use of technology in education.

Ohlman(7) has provided a fairly comprehensive survey and analysis of the present, i.e. 1971, state and future trends of communications media and educational technology. Separate chapters of his work are devoted to still-picture media for instruction, computer-assisted instruction, educational communications satellite systems, and electronic versus physical distribution of educational materials. In this latter chapter, major subsections examine facsimile systems, micro-imaging systems, wired television systems and cassette and disc program storage systems.

Ohlman perceives an overall trend towards replacement of physical means of distribution by electronic means, citing the relatively rapid growth and profitability of telephone versus the postal service in the U.S. He is enthusiastic about the still-picture medium for many learning situations and sees the TICCIT system as a promising approach to development of computer-assisted instruction. Video cassettes are described as having the potential to become as convenient for sight as audio cassettes are for sound, provided that compatibility of equipment is achieved among various systems being or about to become marketed. Future marriages of microfilm with both television and computers are seen as having important future educational uses.

Ohlman also comments briefly on factors affecting future utilization. He finds the introduction of instructional technology into U.S. schools, with few exceptions, to have been "uncoordinated, ineffective and piecemeal." Broad support from teachers, administrators, and the public, long-term commitment from school boards and the establishment of instructional technology on an "integrated, total-systems basis" are called for if educational technology is to become more effective. Media diversity is seen as essential "if a wide variety of student characteristics and instructional situations are to be served in an economical manner." Studies are recommended to gain understanding of the characteristics and limitations of various types of media as well as to determine costs of various alternative delivery methods for instructional programming.(7)

Korman(237) in a report entitled "Innovations in Telecommunications Technology: Implications for Education" examines and projects trends for future development of the following services for education: Educational Television, Closed-Circuit Instructional Television, Instructional Television Fixed Service, Video Tape Recording - Video Cassettes, Satellites, Cable Television, Radio, Telephony and Information Networks. Among the current trends Korman sees in hardware are microminiaturization of equipment and information; increased message transmission capacity; two-way (interactive) information flow; more complex and complete information grids; faster and longer-distance communications; multi-media use of technologies. Trends in software include self-paced instruction, interdisciplinary instruction, greater student involvement as an active learner and element in learning environment design, increased stress on relevancy in the educational process, changing teacher roles (concepts) such as team teaching, and more scheduling flexibility for instruction.

Jamison, Suppes and Wells(34) have reported on a survey they undertook to provide an overview of research on the effectiveness of alternative instructional media. The media considered were traditional classroom instruction (TI), instructional radio (IR), instructional television (ITV), programmed instruction (PI), and computer-assisted instruction (CAI). Achievement test scores were the measures of effectiveness most frequently used. It is concluded that "students learn effectively from all these media, and relatively few studies indicate a significant difference in one medium over another or of one variant of a medium over another."(34) However, the authors point out that the present state of the literature is preliminary in nature as far as providing a basis for deep understanding of the strengths and weaknesses of technological alternatives to traditional instruction.

Considerations of probable importance singled out by Jamison, Suppes and Wells(34) for extensive study in the future include: examination of whether savings in time exhibited in some studies using PI or CAI can be shown to be significant over longer periods and for a larger proportion of the total instructional program of students; more detailed evaluation of impact of various technologies on long-term student motivation; long-term effects of individualized instruction inherent in some technologies; examination of new media uses which may break from the previous mold in which the medium is used as an imitative substitute for the teacher.

In the title of a provocative article, Koerner(29) asks, "Educational Technology: Does it Have a Future in the Classroom?" and then answers his question with a "maybe." He likens asking about the future of educational technology in 1973 to asking in 1903 about the future of the aeroplane. Koerner points out that a great deal of educational technology exists in the form of hardware which does not meet the demands for access, individualization and economy in education. To respond to these demands being made on the educational system becomes a possibility only if educational technology means something more than hardware: "an integrated system of teaching and learning for which the cost is reasonable and for which software has been specifically developed, tested in practice, revised, retested and finally validated...."(29)*

Koerner boils the major technological elements down to five; Broadband communications in which by means of coaxial cable, microwave and satellites today (lasers, glass fibers and other exotic devices in the future), "we have the capability of creating many kinds of telecommunications networks with more or less unlimited capacity. These networks could tie educational institutions together as well as tie them to other kinds of public institutions and directly to homes;" Computers which offer the educator "a means unmatched by anything else he has ever had available for the lightning processing of truly vast amounts of information." Two major CAI experiments, TICCIT and PLATO, will produce "within another three or four years better data about computer learning than we have had in the past;" Video reproduction represented either by videotapes and cassettes or in combination with broadband communications; Miniaturization including such extreme reductions as the 20,000 volume library on American civilization now offered by Encyclopedia Britannica on 20,000 fiche each measuring three by five inches; Books, blackboards and others, including radio.(29)

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*A somewhat similar distinction between two definitions of instructional technology can be found in the Report of the Commission on Instructional Technology (238) which called for future government participation on a much larger scale than before in educational technology endeavors.

Armsey and Dahl(54) prepared a report entitled "An Inquiry Into the Uses of Instructional Technology" published by the Ford Foundation, an organization which has been heavily involved in the development of educational television in the U.S. and to some extent in other countries. The report contains a useful overview of the "things of learning" which are believed to have the potential to make a significant quantitative or qualitative difference in education. Included are television and television-related technologies, film, audio-tape, radio, programmed instruction and means for its presentation, computers, and books. Included are brief descriptions of how each technology works, how they have been used and with what effect in furthering learning and education in the past. Suggestions are made concerning promising uses in education and possible obstacles. In general, no cost estimates are attempted although it is stated that costs of producing effective educational programs in money, skills, testing and revision, and time have been consistently underestimated. The section on television describes various videotape, cassette and disc devices, cable transmission and satellite transmission among others.

Armsey and Dahl identify the following factors which have tended to impede effective use of instructional technology: confusion concerning definitions and objectives; teacher resistance; the "hardware-software dichotomy" in which software lags behind hardware; the lack of conclusive research and evaluation. A concluding chapter outlines conditions believed necessary by the authors to achieve success in utilization of instructional technology: existence of a recognized and generally agreed-upon need; a pervasive desire to meet the need through the use of instructional technology; the existence of a well-articulated purpose to guide the project; the existence of a structure to make success possible or at least not assure failure in advance; leadership at the right level of authority; responsibility and control (strong backing at the top is cited as a basic requirement for swift innovation in a school system), teacher participation and support; the existence of some substantive need for the use of "the things of learning;" a mechanism for measurement and evaluation; adequate resources throughout the project.

The literature reviewed above is only part of what has been written about instructional technology. It does, however, provide a broad overview of the technology and its potential utilization. In what follows, particular educational telecommunications services will be singled out based upon our own analyses.

C. PUBLIC BROADCASTING*

1. Introduction

An important telecommunications service which could emerge as a major factor in the development of a large-scale educational telecommunications system is public broadcasting. Public television and radio have in recent years developed an organizational and networking base which is national in scope as well as goals for nationwide coverage. The emergence of the Corporation for Public Broadcasting, the Public Broadcasting Service and National Public Radio alongside the more traditional commercial broadcasting organizations in the U.S. has fostered large-scale delivery of educationally-related programming.

The phrase "public television" emerged in connection with the work of a Commission on Educational Television sponsored by the Carnegie Corporation of New York.(239) The efforts of this Commission are generally credited with being instrumental in leading to passage of the Public Broadcasting Act of 1967. Although the adjectives "public" and "educational" are sometimes used interchangeably, we use the phrase "public broadcasting" to encompass those activities which up until now have been a major focus of the organizations stemming from 1967 legislation. In general, this focus has been on public affairs or cultural enrichment types of programming, although many of the local stations associated with public broadcasting do air "instructional television" programs. The latter generally connotes more formal, in-school use of television and may be distributed by other means (e.g., Instructional Television Fixed Service, Closed-Circuit TV, etc.).

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*This section is based in part upon a more detailed analysis of public broadcasting by Singh and Morgan. (9)

The Corporation for Public Broadcasting was created as a result of the 1967 Act as a nonprofit, independent corporation empowered to receive funds from both the government and private sources. The 1967 Act specified CPB's role as being to strengthen local public broadcasting stations so that they would better serve their communities, to develop an effective national interconnection of these stations (but not to operate this networking system) and to augment the national inventory of programs (but not to produce any programs itself).

In November, 1969, the Corporation created a new nonprofit, private corporation named the Public Broadcasting Service (PBS) to select, schedule, promote and distribute national programs to the country's non-commercial ETV stations. PBS is a user-controlled distribution system responsible to the stations it serves. It is supported by the Corporation and by the Ford Foundation.*

Early in 1970, CPB formed National Public Radio (NPR), a nonprofit corporation funded by CPB for the principal purpose of providing a national network program service to the non-commercial public radio stations of the U.S. Membership in NPR is open to any institution or organization which operates a non-commercial, public radio station in the U.S. and its territories and which meets certain criteria, including local production capability, length of schedule and antenna power.

Currently both NPR and PBS, the distribution arms of public television, operate interconnections using AT&T facilities through which programs can be distributed to local affiliates. Both of these organizations have expressed interest in satellite utilization in the past although they are currently making little if any use of this technology. In the following section, their requirements for satellite utilization are presented as set forth in a 1971 response to the filing of proposals with the Federal Communications Commission by organizations wishing to own and operate U.S. domestic satellite systems.(240)

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*The Ford Foundation is phasing out its support for public broadcasting.

The picture of the public broadcasting enterprise since the Act of 1967 has generally been one of growth. Section I2 contains statistical information concerning educational television and radio stations (see Figures 14 and 15). That section also contains estimates of stations and financial requirements to reach essentially all of the U.S. population with a public television signal. More detailed information may be found in Ref. (9).

As of 1971, roughly one-quarter of the U.S. population did not have access to public television.(9) Reaching this population by conventional VHF/UHF broadcast stations becomes increasingly expensive because of its dispersed nature, and in some cases impossible due to terrain. Extension of public broadcasting to these areas using satellite technology would seem to be worthy of detailed consideration.

Accompanying the physical growth of public television have been two issues which are interrelated and which are likely to have an impact on the extent to which public broadcasting serves in the future as a delivery mechanism in a large-scale educational telecommunications system which includes instructional programming. The first issue concerns the centralized versus the decentralized nature of the enterprise. The second concerns long-term government financing independent of government control.

Although no serious attempt to analyze these issues will be made, the following comments seem pertinent to the issue of public broadcasting as a delivery mechanism for large-scale educational telecommunications. In the course of this study, public broadcasting has tended to shift from a tendency towards more centralized networking to more local control by stations. In 1974, an arrangement was worked out by which CPB would funnel funds to local stations which would then decide among a list of program offerings they would wish to purchase for local airing.(241) This move towards more local decision-making is believed to have paved the way towards more long-term (five-year) funding for public television at substantially increased levels.

Another trend to emerge has been an increased interest in instructional programming on the part of CPB. Such interest is not new. Local stations associated with public broadcasting have aired instructional programming for many years, using local production sources or mechanisms such as the Great Plains Instructional Television Library, National Instructional Television, and the newly formed Agency for Instructional Television. A study performed for the Corporation and reported in 1971 recommended an increased role for public television in instructional programming(24) although some opposition to increased involvement of CPB in in-school programming has been expressed in testimony concerning the 1971 Public Telecommunications Act.(244) The success of Sesame Street and the Electric Company is undoubtedly a significant factor in spurring consideration of new instructional ventures. Of particular importance is the fact that these two programs, especially Electric Company, are viewed in schools. The formation of a series of task forces during 1974 to study the future role of CPB in several educational sectors is a clear indication of public broadcasting's interest in instructional programming.

2. Public Broadcasting and Satellites

Public broadcasting has kept abreast of developments in satellite technology and, although not yet utilizing the technology to any extent, has given some indication of interest in becoming a future user. In 1971, a study performed for the Public Broadcasting Service by General Electric explored network television distribution systems, including satellites.(243) Both CPB and PBS responded in 1971 to the FCC's request for comments on the applications of companies to operate domestic satellite systems.(240) This reponse, which provides detailed information on public broadcasting's perceived requirements for satellite time and capacity as of 1971, will now be summarized.

PBS has specified its requirements for a satellite distribution service as two full-time, nonpre-emptible channels with adquate backup for sun outage, eclipse operation, and potential transponder failure. These channels will permit PBS to deliver a national programming service providing one single package to the Eastern and Central time zones and another package, similar to the previous one but displaced in time by three hours, for the West Coast, i.e., Pacific time zone. The Mountain States will be served by a local delay center at Denver and through the terrestrial facilities leased by the Rocky Mountain Public Broadcasting Network (RMPBN). NPR has stated similar requirements for public radio, i.e., a time-delayed package for the Western time zones. In addition to these channels, primarily needed between 6 AM and 12 PM local time, public broadcasting will also require distribution facilities on a part-time and occasional basis. PBS estimates that some 31 hr/week will be required for regional programming, special time delays, and program assembly. As of 1971, the PBS network split into five regional networks for 1 hr/week of prime time regional programming. However, PBS can schedule the network split to reduce its maximum requirement to 1 additional channel hour per day, 5 days/week.

In addition to provision for regional splits, special time delays in the two time zones not delayed by the basic service would be needed to accommodate supplemental type instructional programming within local school schedules. PBS has estimated its requirements for special time delays as 2 additional hours/day for 5 days/week. As of 1971, PBS and its member stations were developing an expanded series of public affairs programs that would draw on member stations. To permit program assembly, part-time access to a channel will be required. PBS estimates that it would require some 2 hr/day, 7 days/wk, with 2 extra hours on Fridays. Also there is a need for occasional access to a satellite channel for covering unexpected special events that cannot be accommodated within the full-time or supplemental services described above. The location of 28 proposed PBS television origination points is shown in Figure 32.

Currently radio networking and TV networking is limited to rather low quality audio based on 3.5 kHz to 5 kHz wide channels because of the unavailability of high-quality, long-distance terrestrial facilities for audio. NPR presently prerecords high-quality and stereophonic programs and distributes them by mail. However, satellites offer a distinct possibility for distribution of high-quality (15 kHz) stereophonic audio signals with accompanying order wire capability and would permit real-time transmission of such programs. Public television and public radio service requirements are summarized in more detail in Ref. (9).

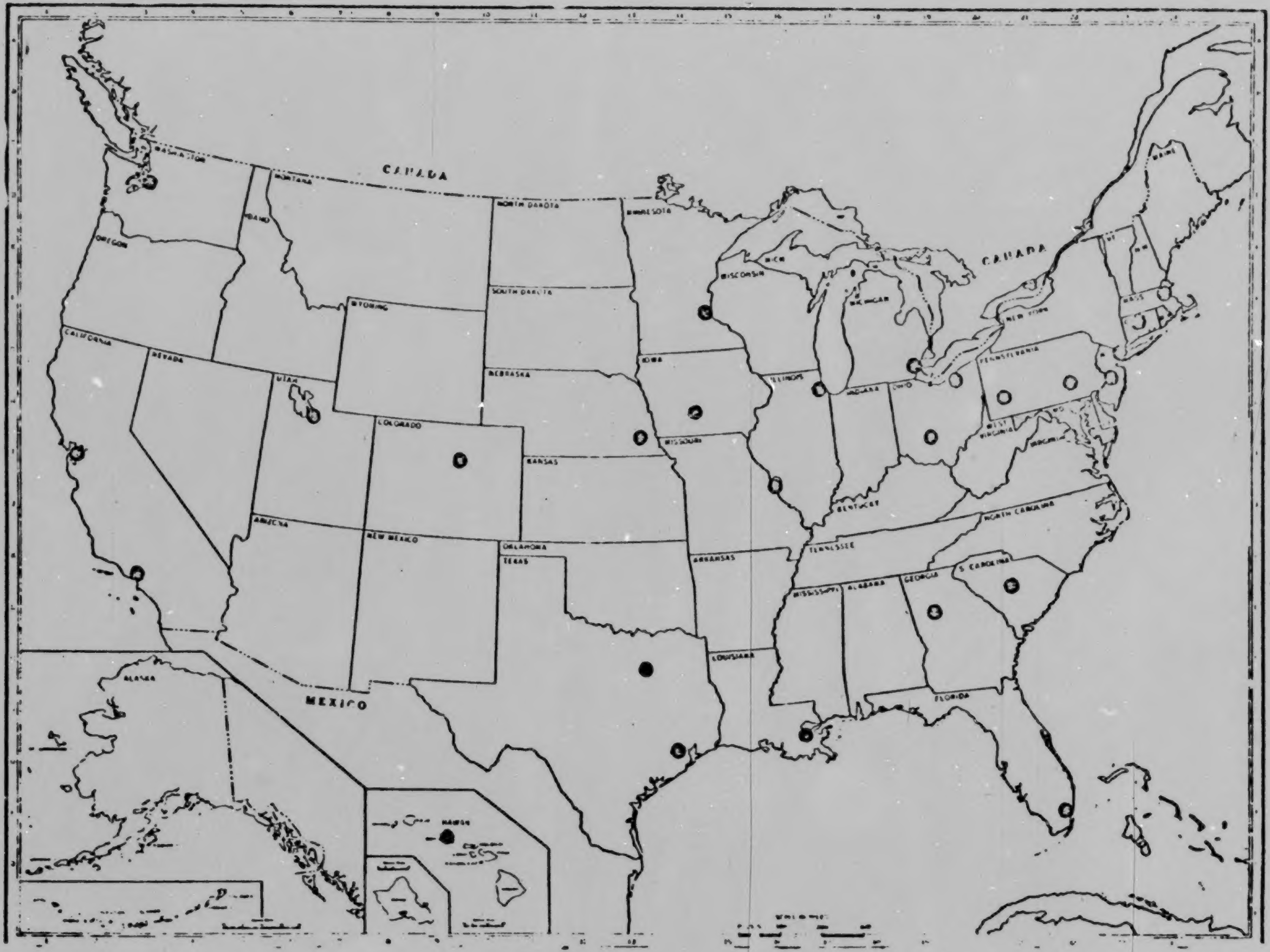
CANADA
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
IDAHO
OREGON
WISCONSIN
MICH
CANADA
VT
NH
MAINE
SOUTH DAKOTA
WYOMING
MICHIGAN
NEW YORK
MASS
CALIFORNIA
NEVADA
IOWA
PENNSYLVANIA
ILLINOIS
INDIANA
OHIO
UTAH
NEBRASKA
COLORADO
MISSOURI
WEST VIRGINIA
VIRGINIA
KANSAS
KENTUCKY
NORTH CAROLINA
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
TENNESSEE
ARKANSAS
S CAROLINA
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
FLORIDA
ALASKA
MEXICO
HAWAII

Figure 32. PROPOSED PUBLIC BROADCASTING ORIGINATION POINTS [Ref. 240]

Public television and radio represent important segments of a potential large-scale educational telecommunications system. Because of their organizational structure and purpose, they were able in 1971 to define reasonably well their specific needs for satellite channels. They have shown considerable interest in capitalizing upon satellite technology, being involved in the ATS-6 HET satellite experiment and are very likely to play a significant role in determining future educational satellite system developments.

A number of different levels of involvement of public broadcasting with satellite technology in the future might be envisioned. Short-term involvement might include supplementing or extending existing ground-based delivery, or eventual replacement of some ground distribution by satellites. Decisions concerning such undertakings would require careful analysis of economic and operational tradeoffs. More long range involvement could include satellite-cable interconnection to bring second public broadcasting stations to many areas.

Early in 1975, a joint planning effort was underway between PBS, CPB and the Ford Foundation to study the feasibility of interconnecting 150 public broadcasting stations via satellite. Discussions were being held with commercial domestic satellite operators based upon a channel requirement of four full-time transponders.* These new requirements would appear to supercede those set forth in the earlier 1971 filings and which are summarized in this section.

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*Personal communication, D. Wells (PBS) to R. P. Morgan, March 17, 1975.

D. INSTRUCTIONAL TELEVISION*

1. Introduction

Television is the medium probably most familiar to Americans. Instructional television connotes the use of television within an organized educational setting. The previous section explored public television, which represents only one component of existing delivery modes for instructionally-related programming. In this section, the broader field of instructional television is explored, with emphasis on identifying instructional television services suitable for a large-scale educational telecommunications system. The reader is also referred to relevant discussions of television use in specific educational subsectors, particularly elementary and secondary education (Section IIB) and higher education (Section IIC).

There are a variety of technologies which are being used to distribute instructional television. These include: a) UHF and VHF broadcast stations, b) cable television systems, c) instructional television fixed service, d) mailing of videotapes, e) closed-circuit television, f) microwave and laser links. Some of these are more prominent than others at specific educational levels. Wong has recently concluded a study of technology-based networks for higher education in which information on some twenty-six systems delivering televised instruction to off-campus sites is presented.(19A) A study by Morris, et al. of continuing engineering education via television presents cost comparisons for ITFS, videotape and microwave networks for varying user populations and geographic distributions.(93) Work is currently underway by Ballard and Eastwood of our research group to provide a firmer base of information on alternative technologies and their costs with which to perform educational telecommunications system syntheses.

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*Portions of this section are based upon more extensive analyses by Dumolin(10) and by Singh and Morgan. (9)

Three organizations have played an interesting role historically in instructional television software distribution at the elementary and secondary school level. MPATI (Midwest Program on Airborne Television) transmitted television programs to schools in several midwestern states from an airplane. The flights were then terminated and MPATI continued to distribute instructional tapes.(7) NIT (National Instructional Television) is a going concern which produces and distributes videotapes. Operation of NIT has recently (1973) been assumed by the Agency for Instructional Television, a not-for-profit group established by the Council of Chief State School Officers and the Canadian Council of Ministers of Education in order to foster the cooperative production of better instructional television programming.(245) GPNITL (Great Plains National Instructional Television Library) serves as a distribution point for duplication and mailing of instructional television tapes. GPNITL is located in Lincoln, Nebraska, headquarters of the State University of Nebraska Open University project. These organizations, along with local efforts by schools and public broadcasting stations, represent the current infrastructure for ITV software production and distribution in addition to the somewhat limited involvement to date of CPB and PBS.

2. ITV Utilization

A dearth of information exists on the extent to which television is used in classrooms or other organized educational settings leading to certification. However, the information available prior to 1972 indicated that instructional television was used very sparingly in the classroom. A 1967 study of utilization in 16 major cities indicated that less than 3% of classroom time in schools was devoted to television.(246)

In the past, fragmented local production of materials has been one of several factors which are believed to have prevented extensive use of the medium. However, a steady trend, especially for VHF/UHF stations, has reduced the level of local production from 77.9% of the hours broadcast in 1962, to only 27.2% in 1970. (247) From 1968 to 1970, Instructional Television Fixed Service (ITFS) and Closed-Circuit Television (CCTV) have reduced local programming from 57.9% and 72.4% of their broadcast time to 42.1% and 54.6%, respectively. This broad reduction in local production is due to increased utilization of national and regional production and distribution sources such as NIT, GPITL, and MPATI.

Closed-circuit television encompasses a broad array of technologies and a wide range of operations. On one hand, a closed circuit system could be a mobile, portable videotape recorder, TV monitor and camera. On the other hand, it could be an interstate network linked by microwave. The important distinction between a closed-circuit system and conventional broadcast television is that in the former, there is limited access to the signal at relatively few distribution points, whereas in the latter, anyone with a television set within range of the signal can pick it up. Limitations to broadcast television for instructional purposes which have stimulated interest in CCTV include lack of sufficient broadcast spectrum (television is a relatively large user of bandwidth compared with other media), one-way only transmission and the possibility of reception by unauthorized users.

The last comprehensive survey of closed-circuit television (CCTV) was carried out in 1967. Data are hard to obtain because of the wide variety of equipment and facilities that can be defined as CCTV. However, there has been a rapid growth since the 812 installations reported in 1967, with use divided almost evenly between higher education on one hand and elementary and secondary education on the other, and with a large local production component. The minimum requirement for being counted as a CCTV facility in the 1967 NEA survey was a VTR, TV monitor and camera. Some 22% of all 82,000 public elementary and secondary schools were reported to own both VTR's and TV sets. (128) That number is likely to have increased with the increased availability of low-cost videotape equipment. At that time some 75% of these schools had TV sets.

Instructional Television Fixed Service (ITFS) is primarily designed for linking closed-circuit TV installations in various schools with each other or to a central transmitting station over distances of up to 20 miles. This serivce was initiated in 1963 when the FCC opened up 31 channels in the 2500-2690 MHz frequency range for use by educational institutions and organizations.(248) This is the same frequency band as is allocated for educational satellite utilization.

As of September 1970, there were some 157 ITFS systems totaling 556 channels. (See Figure 17 .) Approximately one-third are owned by religious organizations and are used for instruction in parochial school systems. The bulk of the remainder evenly divides between universities, school districts, and county ownership. In general, ITFS has been used solely to distribute instructional TV material to traditional classroom situations, with very little application for computer-communications, data transmission or educational administration. A number of instructional networks have come into being, particularly at the higher education level, which make use of ITFS such as the Stanford Instructional Television Network.(9)

An important development which may affect the local distribution of electronic educational media is the growth of CATV or cable television. (See Figure 18.) In 1950, there were only 5 such installations but by 1953, there were almost 300 systems. By 1973 this number had grown to over 2400 serving more than 5 million TV households out of a total of 62 million.(39) Although originated solely for the purpose of providing access to distant TV channels in order to achieve greater program diversity and improved reception, cable-TV is now being installed in major cities and is being contemplated for use in providing a wide spectrum of services in the so-called "wired city" or "Broad-Band Communications Network." One important reason for the interest in and growth of cable-TV is the large channel capacity of this "non-radiating" medium in which 20 to 40 TV equivalent channels are coming into being. These channels do not consume over-the-air frequency spectrum and therefore do not cause interference to other neighboring services operating in the same frequency band.

The educational potential of cable-TV has been recognized and is just beginning to be exploited. A study by Barnett and Denzau highlights the potential benefits of a dedicated educational 40 channel cable system interconnecting schools and allowing flexibility in use through repetitive program transmission.(45) A proposal by Hughes Aircraft to the FCC contemplated interconnecting cable-TV headends via satellite.(6) The CATV-satellite combination offers a potential solution for a second nationwide ETV service which otherwise would be impossible to implement on a nationwide basis because of the scarcity of second ETV broadcast channel allocations in most areas.

Some of the problems associated with use of cable for distribution of instructional television in schools have been discussed in Section IIB4. Commercial cable does not appear to be developing as rapidly as had been anticipated, particularly in large urban areas. Furthermore, commercial cable systems may offer relatively few new benefits in view of the limited channel capacity for educational programming. Dedicated educational cable systems involving more than the wiring of one school do not appear to be widespread, and much remains to be done if cable is to realize its educational potential.

Although cable appears to show some promise for linking district centers to schools in urban and suburban areas, economic linkage of district centers to national and regional production and storage libraries will probably be accomplished by other means. At present, some networking is being done by the Public Broadcasting Service, and some statewide systems are using AT&T long lines to interconnect various stations. Figure 16 depicts the status of inter- and intra-state educational communications networks as of 1972. The use of such networking appears to be growing, particularly in higher education.

Communications satellites represent an alternative means of distributing instructional television programming over long distances for regional and/or national distribution. Potential uses of satellites are indicated in Table 6. Experiments involving instructional satellite video transmissions are summarized in Table 4 and Section IIC4.

Only a fraction of future overall ITV utilization need necessarily be distributed by long-distance telecommunications. Although there is a strong trend away from local production of instructional materials, both

CCTV and ITFS still make heavy use of local production with about half of these programs in this category. Higher education is a heavy user of CCTV and ITFS is favored by parochial schools. However, the satellite could potentially carry a significant fraction of those particular programs (science and mathematics, current events) which are universal in language and can be distributed widely. Such distribution could take place not only to rural schools but to urban centers as well via cable-TV headends and ITFS.

The desirability of increasing instructional television programming budgets from their very low initial levels to those more nearly approaching commercial TV is evident. The initial Sesame Street program production costs of $40,000/hr probably represents the high end of the range, but costs on the order of $10,000/hr would not seem unreasonable. A range of from $2000-$40,000 probably would be all-inclusive for nationally distributed programming. If these large programming costs can be spread over large user populations, the economics for utilization becomes more favorable. Delivery via satellite offers the potential for rapid, widespread distribution. This must be balanced against local needs and requirements and the organizational and administrative problems associated with a large-scale distribution system.

E. COMPUTER-ASSISTED INSTRUCTION*

1. Introduction

Computer-assisted instruction represents a newer educational telecommunications service than instructional television, having developed since about 1960. The many applications of computers in education are summarized in Figure 2 and in Section IIC4, which contains essential background information for this discussion. In Section IIF, we will examine computer resource sharing or networking primarily for the purposes of providing computing power for research or administrative uses. In this section, we limit our concern to instruction "with" computers and more specifically to what has come to be known as "computer-aided instruction."

The phrase "computer-aided instruction" has been used somewhat loosely and in various ways. It is sometimes used interchangeably with the phrase "computer-based instruction" although the latter can connote a wider and more central role for computers in instruction than CAI. We have interpreted CAI as being a man-machine relationship in which the computer is used to aid and abet both teachers and students in the educational process.(249) Aid to the teacher often comes in the form of diagnostic or prescriptive information to assist in making decisions about new instructional activities for students - a process usually termed "computer-managed instruction" (CMI).

The most common form of computer-aided instruction used by students is "drill-and-practice." The students sit in front of a terminal device such as a cathode-ray tube as in the TICCIT system or a plasma panel as in the Plato-IV system. (See Section IIC4.) A problem in mathematics or spelling, for example, is presented on the screen and the student must respond by pushing a key or using a light pen. The terminal, which is connected to a computer, indicates whether or not the student is correct and, based upon the response, the student is given a new problem. In computer-managed instruction (CMI), track is kept of student performance on CAI programs and the results are used to design or select further work for the student.(250)

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*This section is based in part on work by Singh and Morgan. See Ref. (8) for further details.

CAI programs can also be designed to teach concepts, values or skills. These programs can be classified as tutorial. According to Schoen, CAI tutorial programs, although borrowing heavily from the theory of programmed instruction (PI), have many potential advantages over PI. The extent to which CAI is a form of PI has been a subject of some controversy. In the PLATO system, teaching strategies which do not require specified student responses are widely used and they have been cited as being of greater value than strategies requiring specific responses in many fields and levels of information.(251)

The many different opinions and approaches concerning CAI attest to its relative newness and the current experimental and/or demonstration phase of development. Pilot programs using CAI have been initiated in several large cities, with government funding in connection with programs to aid students who tended to perform below average in certain cognitive areas. Evaluations have indicated that CAI has the potential for improving student performance and for shortening the time required to learn subject matter.(203) In this section, we restrict ourselves to some considerations germane to the dissemination of CAI in large-scale educational telecommunications systems. The reader is also referred to Sections IIB and IIC for pertinent information and to the writings of leaders in the CAI field for further insight into this potentially important future educational element.(62, 99, 102, 251, 252, 253)

2. CAI Utilization

According to an NEA survey conducted in the spring of 1970, 7.7% of all elementary and secondary school teachers who were questioned indicated that their school systems were using CAI, with more use in the Northeast and Middle States than in the Southeast and West, and more use in urban and suburban areas than in rural ones.(254) In general, CAI is still in the research and development phase with primary use clustered around research centers. (See Figure 33.) According to a survey published in 1970(255) the costs of most CAI systems in use then were quite high, falling in the range of from $2.60 to $15/student hour as compared with traditionally administered (teacher) instruction (TAI) costs of roughly $0.60/student hour for elementary and secondary education and $1.50/ student hour for higher education.(9) Further CAI cost reductions are clearly required if it is to be cost-competitive with TAI. Reductions should in fact be possible; for example, the Plato IV system is projected to achieve a cost of roughly $0.34/student contact-hour through the use of large, time-shared computers and plasma display panels.(52) However, a recent paper by Eastwood and Ballard projects considerably higher costs.(309)

At one extreme, the largest potential savings would appear to stem from substitution of the computer for the teacher, a step which if taken on a large scale at certain educational levels would be likely to meet with considerable resistance and, if taken, could have far-reaching implications, many of which cannot now be foreseen. At the elementary school level, a major problem is the conflict between the organization

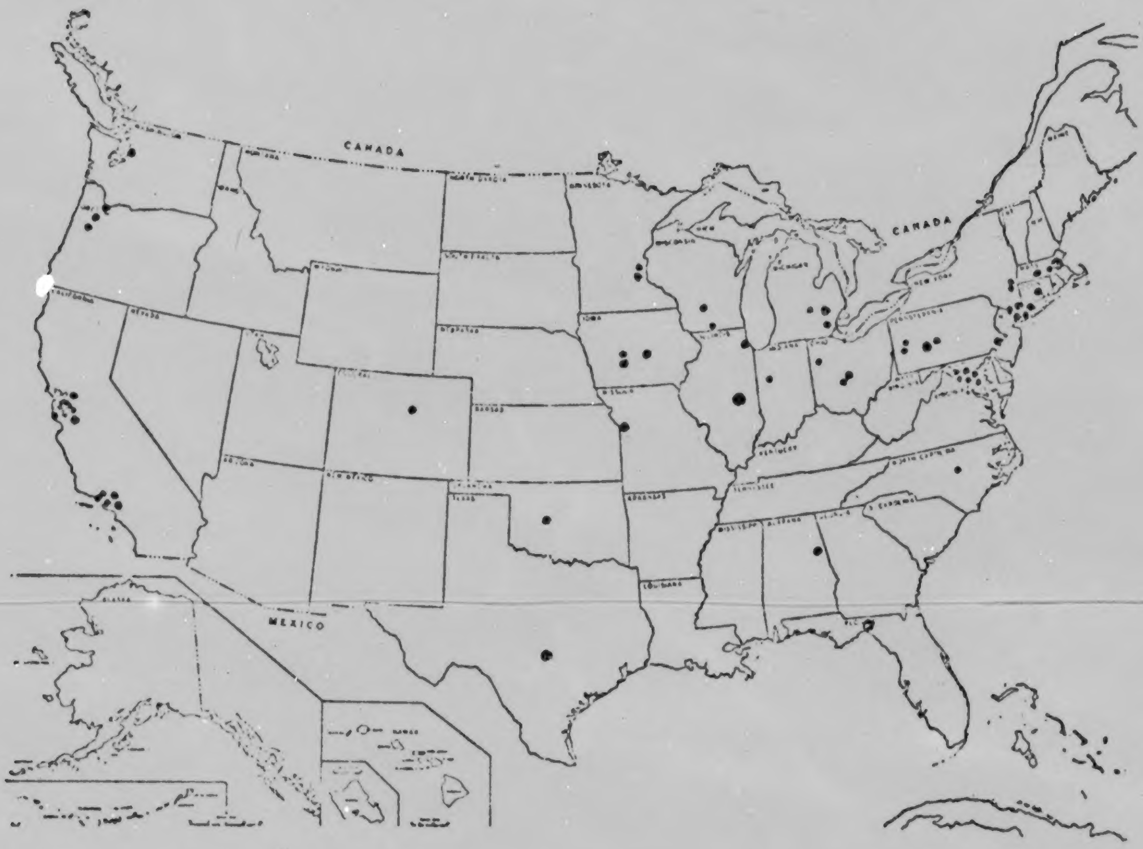
CANADA
CANADA
MEXICO

FIGURE 33.—LOCATION AND DISTRIBUTION OF MAJOR CAI CENTERS, (1970)
(Developed from data in Ref. (256))

of the traditional school system and optimal methods of utilizing computer-aided instruction. The federally supported developmental thrust of CAI systems now seems to be at the community college level (see Section IIC4.) Further discussion of these and other issues related to CAI utilization as well as a summary of a variety of CAI experiments and approaches can be found in a report by Singh and Morgan.(9)

It should be remembered that the software is the heart of the CAI system and its effectiveness very much depends upon the quality of software in use. Feldhausen and Lorton(255) have expressed a need for more exciting and effective programming. Assume that an hour's worth of good CAI instructional material (for drill-and-practice) prepared by interdisciplinary teams of psychologists, subject experts and programmers costs \$5,000-\$8,000. If this program is developed exclusively for a school with an average class strength of 32 pupils, the software cost alone would be something like \$31-50 per student hour for a drill-and-practice program life of five years. For tutorial type software, the costs will be even higher. This points out to the need for economies of scale, i.e., resorting to mass distribution and preparation of CAI programs. However, mass distribution would require certain steps in the area of the compatibility of computers, input/output devices and programs. Today there is a multiplicity of CAI languages and many instructional programs are even written in assembly languages. The problem of incompatibility is not unique to CAI. It is true for the newly developing electronic video recorders and cassette players. However, this situation would have to be resolved if the cost of preparing good CAI material is to be justified and CAI systems are to compare favorably with TAI in cost.(11)

3. CAI Distribution

There are three quite different lines along which CAI systems are being developed and implemented.(251, 257, 258) One, a highly decentralized approach, is that of a low-cost computer serving a small number of student terminals (5 to 20) at a single location. On the other extreme would be a highly centralized system with a single high capacity computer to serve a large number (several hundred or more) of terminals over a broad geographical region. In between these two extremes, there can be a system in which several terminals in every school form a sort of cluster and these clusters have their own limited mass storage and processors. At the same time, these clusters are tied to a common single processor whose hardware and software capabilities are shared by the various connected clusters. Cluster operation is fairly independent to some degree, but nevertheless dependent upon the hardware and software residing in the central processor. Operation of the clusters over an extended period of time requires availability of, and participation by the central facility.

Figures 34 to 36 show the schematics of the three types of CAI systems. An example of the totally decentralized type of system would be the CAI system under production at Computer Curriculum Corporation (CCC) of Palo Alto, California.(257) It is an eight terminal system that will be used for drill and practice in arithmetic (grades 1-8). On the other end are versatile, large CAI systems such as PLATO IV which was planned to have 4000 terminals and an initial cost of $13.5 million as opposed to $30,000-$40,000 for CCC type systems. The CAI system operated by the Philadelphia School System belongs to the third category

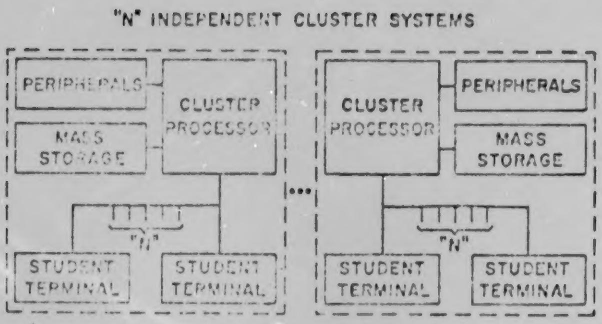
"N" INDEPENDENT CLUSTER SYSTEMS
PERIPHERALS
CLUSTER PROCESSOR
MASS STORAGE
"N"
STUDENT TERMINAL
STUDENT TERMINAL
CLUSTER PROCESSOR
PERIPHERALS
MASS STORAGE
"N"
STUDENT TERMINAL
STUDENT TERMINAL

Figure 34. Decentralized CAI System

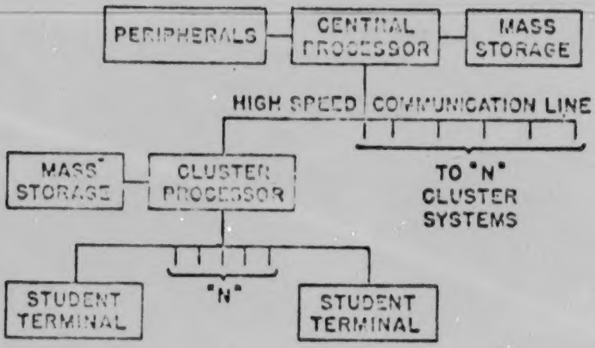
PERIPHERALS
CENTRAL PROCESSOR
MASS STORAGE
HIGH SPEED COMMUNICATION LINE
MASS STORAGE
CLUSTER PROCESSOR
TO "N" CLUSTER SYSTEMS
STUDENT TERMINAL
"N"
STUDENT TERMINAL

Figure 35. Combined Central-Cluster Operation

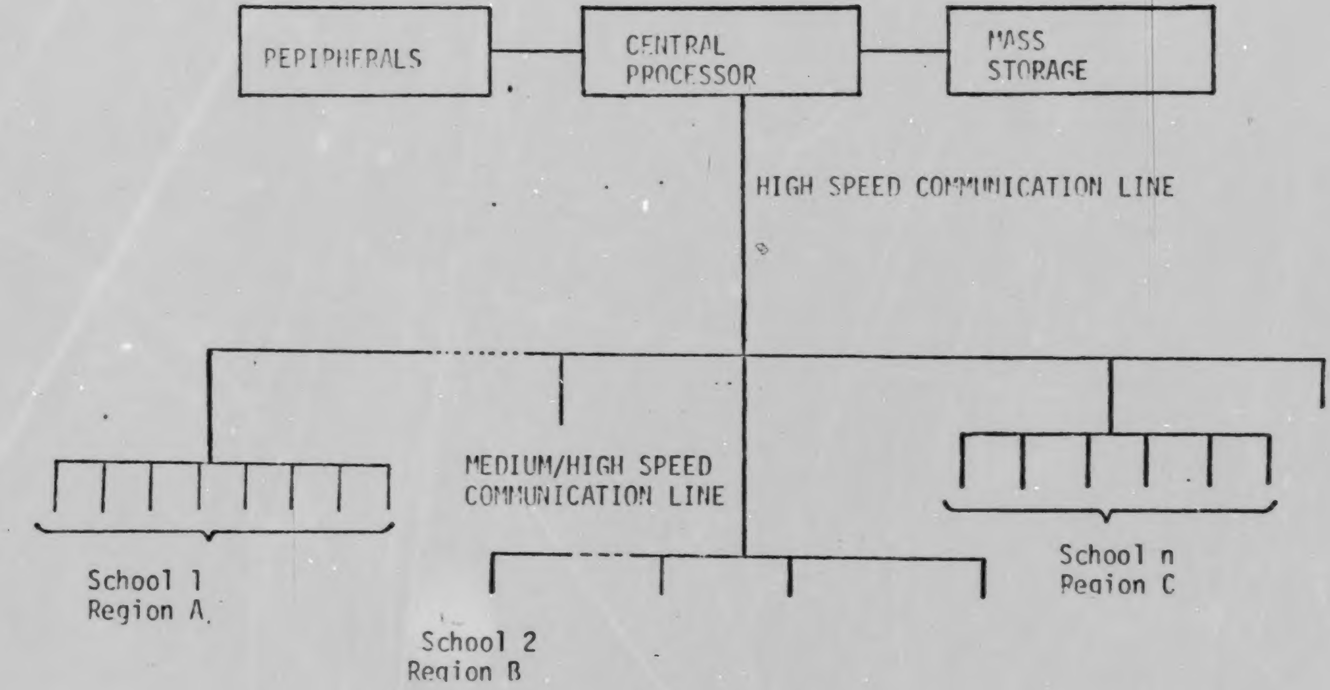
PERIPHERALS
CENTRAL PROCESSOR
MASS STORAGE
HIGH SPEED COMMUNICATION LINE
MEDIUM/HIGH SPEED COMMUNICATION LINE
School 1
Region A
School 2
Region B
School n
Region C

FIGURE 36. A HIGHLY CENTRALIZED CAI SYSTEM

of combined central and cluster processing.

The centralized system approach can lead to economies in the allocation of mass storage facilities especially when course material is common to more than one school or school system. In a centralized system, no mass storage capacity is required as each terminal is capable of interacting independently with the central facility. As far as systems based on combined central and cluster processing are concerned, each cluster requires only that sufficient mass storage capacity be available at the cluster location to maintain its immediate needs of lesson presentation as dictated by student and student-terminal characteristics. The cluster calls for additional material to be transmitted from the central facility prior to the actual need and in accordance with daily schedules prepared in advance. The curriculum library for all clusters, as it is common, is maintained at the central facility through a combination of serial access and random storage devices. At the cluster, the quantity of storage on-line is sufficient to supply course material to n-terminals for one, two, or more hours. In a completely decentralized system, total curriculum would have to be maintained at each cluster location in addition to the cost multiplication for various peripheral devices at each cluster, which under the centralized system are shared by all clusters.

Interactive telecommunications requirements of completely decentralized CAI/CMI systems are entirely local, i.e., between the terminals and the processor which are located within the same physical facility. Programs could be distributed either by transporting magnetic tapes and discs, as the case may be, or by wideband telecommunications depending upon the requirements. CAI/CMI systems, based upon combined central and cluster processing, require wideband communication links between the central processor and mass storage and the cluster processor and mass storage. Local telecommunications requirements for linking terminals with the cluster processor are the same as in the case of completely decentralized systems. Totally centralized CAI/CMI systems have altogether a different requirement. Here the critical aspect of the economic viability is the cost of communication. Incoming and outgoing information for a number of terminals located in a single school can be multiplexed and transmitted together.

The digital data which makes up the CAI messages can be transmitted by a variety of means. Telephone lines like in the Plato-IV system and cables like in the TICCIT system are but two of the possibilities. Many of the transmission media used for television (see Section IIID) can also be used to transmit digital data. Once again, economic analyses are required to minimize communications costs for a desired level of service.*

Extending CAI/CMI services to isolated, not-so-affluent and small rural schools is a difficult but potentially rewarding task. For rural schools, ways may have to be devised in which hardware costs can be shared by a large enough population so that CAI costs for rural areas are comparable to those in urban and suburban schools with larger student densities. Unless decentralized minicomputers prove to be attractive, some means of low-cost telecommunications must be found if rural communities and sparsely populated regions are to benefit through low per-pupil costs based upon large-scale and intensive utilization.

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*Some idea of the technical communications requirements for CAI are as follows. Speed of incoming data (from processor to the individual terminal) may be anywhere between 14 bits/second to 200 kilobits/second depending upon whether the information being transmitted is pictorial, voice, alphanumeric or terminal address. In a large scale system like TICCIT, it is estimated that, during any one second, 10 percent of the frames transmitted would be pictorial or voice (200,000 bits), and 90 percent would be alphanumeric (10,000 bits) in addition to 1,000 terminal addresses (14 bits) under the assumption the average frame change would be something like 10 seconds. This adds up to a 30 megabits/second. (259) As opposed to this, the outgoing data rate is trivial (20 bits/second per terminal). For a 100-terminal setup, it would be 2 kilobits/second and could be easily accommodated on a Data-Phone line if a data concentrator is used. In the PLATO IV system, the peak data rate from the computer to each student terminal is limited to 1.2 kilobits/second and thus for 4000 terminals, the worse case data rate is about 4.8 megabits/second. A data rate of 60 bits/second is anticipated for transmitting the student keyset information back to the main computer center. (52)

Analyses indicate that communications satellites seem to hold distinct advantages over existing commercial telephone communications for linking remote terminal clusters with a central computer where computer-cluster separation is 150-200 miles or greater.(9, 260) A specially designed high power satellite capable of delivering signals to low-cost small-diameter antenna headends could provide a variety of services for educational users in addition to CAI, such as remote batch processing of administrative and educational data, public and instructional television, remote electronic browsing, etc. More detailed systems analyses and cost-benefit studies are needed. No insurmountable technical problems are foreseen. In the next 10-15 years the beginning of a period of more extensive CAI utilization is expected. (See Chapter IV.) Primary areas of CAI application are likely to be those with a highly structured nature such as mathematics, sciences, etc.

CAI delivery to remote areas via satellite will have to compete against the alternative offered by a minicomputer. However, the advantages of a greater variety of services including raw computing power (batch as well as interactive) and languages offered by interconnection to a "supercomputer" are likely to have their own attractiveness. The decision for satellite-based delivery also will depend upon the terminal population that is to be served at a particular location as well as the nature of the terminals in use and the separation between the computer and the terminal cluster. If the terminal cluster is composed entirely of teletypes requiring low data-rate inputs, the satellite-based service would not be economically viable for interconnection distances less than 200-300 miles, depending upon the cluster as well as over-all terminal population. If the terminals have a display capability requiring relatively high data-rate inputs (a few kbits/sec), the satellite service or interconnection may become viable for distances as short as 40-60 miles.(9) More detailed analyses of CAI distribution to remote areas are currently being carried out by Morley and Eastwood of our research group.

F. COMPUTER RESOURCE SHARING*

1. Introduction

The spectrum of uses for computers in education was introduced in Figure 2 and Section IIC4c and the basic rationale behind computer resource sharing was developed in Section IIC4d. Computers currently are being used in education for a variety of purposes - e.g., instruction, research, administration, information retrieval, and career guidance at a variety of levels - and for elementary, secondary, higher, and vocational education. Over-all computer utilization has grown rapidly in the U.S. since 1962. At the elementary and secondary school level, the primary use appears to be for administration, whereas for higher education, utilization is divided equally among research, instruction, and administration.

According to a Survey of Computing Activities in Secondary Schools conducted in 1970(261) some 34.4% of the secondary schools reported some kind of computing activity. Of the schools responding to the survey, 30.5% were using computers for administrative purposes and only 12.9% reported instructional usage. Geographic dispersion of these user schools showed clustering around major metropolitan areas. (See Figure 37.) Even in these cities, instructional users were not satisfied with the presently available access to the computer.

Extensive use of computers by colleges and universities began in the early 1960's and has grown rapidly. Larger schools and those granting higher degrees have greater access to computing facilities than smaller schools and those that do not grant higher degrees. In 1967, the President's

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*This section is based upon an extensive analysis of educational computer utilization and computer communications by Singh and Morgan. (11)

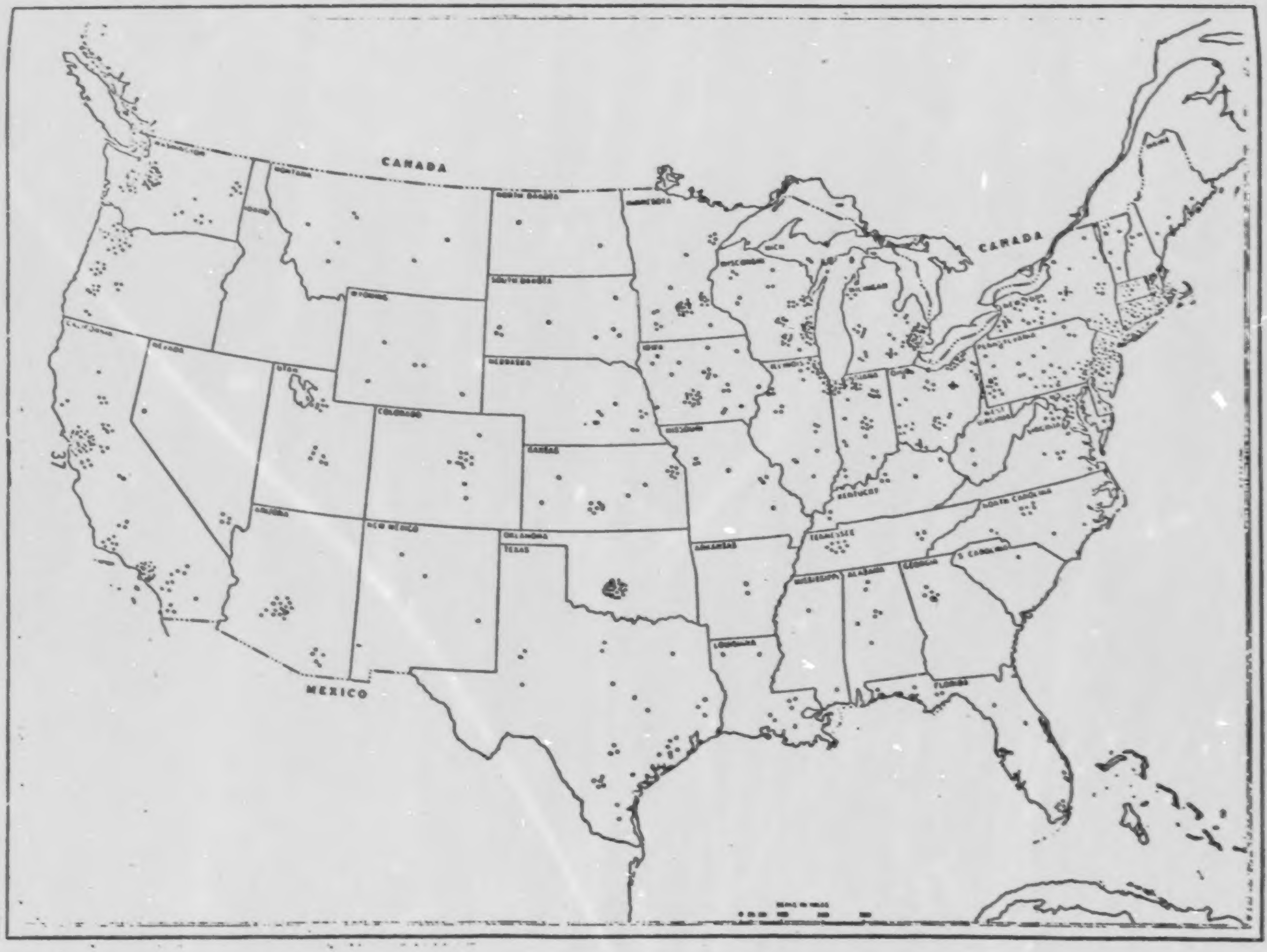
CANADA
CANADA
MEXICO
37

Figure 37. Geographical Distribution of Secondary Institutions Using Electronic Computers [Ref.261] (1970)

Science Advisory Committee (PSAC) recommended some 20 minutes of computer time/student/yr as a goal for computer usage in higher education. However, about half of the nation's colleges and universities were entirely without computer services as the 1970's began.(11)

The essential rationale behind computer resource sharing is to provide institutions, many of which may lack computing capability, with access to the computing resources of other institutions. The benefits to be derived from such an arrangement and the pros and cons between computer resource sharing on one hand and minicomputers on the other were explored to some extent in Section IIC and in more detail elsewhere.(11, 69, 70)

A survey of computing facilities was carried out by Singh and Morgan in 1972 in connection with a study sponsored by the Appalachian Regional Commission.(206) Respondents at about half of the region's colleges felt that existing computing facilities were adequate to meet current needs whereas about 40% felt that existing capabilities fell short of what is needed. Only nine of 123 institutions with some form of computing capability reported a surplus of that capability.

2. Modes of User Access and Sources of Service

Table 23 provides a matrix of the various forms of computer access arrayed against the sources available to educational institutions for computer services. Modes of access vary from "batch processing" in which one user submits his job to a computing facility and cannot interact with the computer, to "time-sharing" in which a number of users can interact with a computer essentially simultaneously from remotely located terminals. Each of the modes of access require differing amounts of communications capability. Further definitions as well as some technical and cost considerations can be found in Ref. (11).

TABLE 23.

MATRIX OF COMPUTER ACCESS AND SOURCE OPTIONS[*]

Source of Service	Mode of Access				
	Dedicated	Batch Processing	Remote Batch Processing	Multi-Programming	Time-Sharing
Centralized On-Campus Facility	X	X	X	X	X
Distributed Computers On-Campus	X	X		X	
Commercial Service Off-Campus		X	X		X
Shared Cooperative Facility Off-Campus		X	X		X

[*] Developed from Refs. (262, 263)

Centralized on-campus computer facilities have often been the unquestioned choice of educational institutions, particularly those belonging to higher education, because such facilities have the appearance of a scientific or instructional tool. Depending on size, budget, and user needs, such a center can provide user access in any of the five modes described in Table 23. A college with few users, each with small problems, may very well select a single task system. When such a system becomes congested, the college may move to a batch processing system. Remote batch is not inexpensive; it will be considered in institutions large enough (geographically) to make physical access a serious problem. An institution with many users and a sufficient budget will certainly consider an on-campus, time-sharing system as an attractive alternative. The advantages of centralization arise from economies in computer cost resulting from fuller utilization of large scale, lower cost-per-unit of computation machines, and from sharing of scarce staff, programs, and facilities. The disadvantages derive from a central facility's relative unresponsiveness to local time-urgent demands and from the problem of providing and balancing the wide range of services demanded on an active campus.

A totally different approach to on-campus facilities is possible where each user group is left to provide for its own requirements, usually with the acquisition of small computers. There are often good reasons for allowing some users to have their own machines dedicated to their own problems: computer science students must sometimes undertake experiments that would be disruptive of normal service; administrative users may feel that their privacy, load and job-mix requirements are incompatible with a multiple-user service; research users may have experimental control requirements (very fast response time, reliability, etc.) that can not be met by any centralized facility without unusual inconvenience and expense. Distributed computers, like those in a centralized facility, can provide access in several modes. Because they are used by fewer people, they are normally smaller and thus more likely to be used in the dedicated or batch mode. Disadvantages generally attached with a distributed facility are higher cost per unit of computation than for large machines and the fact that sharing of programs and services has been harder.

Service Bureaus and the newly developing computer utilities offer another source for procuring necessary computing power. Service Bureaus purchase or lease computer equipment and hire staffs of programmers, analysts and operators. They offer computer services to others, providing an alternative or supplementary source of computation for the users who prefer not to obtain equivalent equipment directly. Though no new data was available as of 1971 on the population of these Service Bureaus, in 1966 there were over 800 of them.(264) Time-shared vendors or "computer utilities" could be differentiated from the service bureaus on the basis of the use of remote input/output stations. Computer utilities provide both time-shared computing as well as remote batch processing, whereas Service Bureau services are mainly limited to Batch Processing and the user is required to physically transport his program to the Service Bureau facility.

A large number of "computer utilities" have come into existence and their number is increasing. A 1971 survey(265) provides detailed information regarding various time-sharing services - area covered, facilities CPU, response time, charges, file structure, software, applications packages, and multi-user, on-line data bases, if any. These have very attractive characteristics for institutions making their first investment in computing, since the set-up costs are small, the convenience is great, and the price is very largely a function of how much of the service is used. The institution has the choice of browsing around and buying the suitable service from a large number of strongly competitive time-sharing vendors or utilities. If an institution decides that it is preferable not to provide any computer on campus, but to arrange for the service through some utility or service bureau, the reasons are likely to be one or more of these: (1) It is less expensive (capital and/or operating expense); (2) It requires less long term commitment; (3) It requires less management or administrative supervision; and (4) It provides higher quality and wider variety of services than those obtainable through a smaller computer system on-campus.(262) Some institutions will select this alternative when their need is for very little computing (thus making other alternatives relatively more expensive), when the need is imminent (and there is no time to arrange for other alternatives), or when it is expected that the requirements will drop off very soon or the requirement profile has a large variation with respect to time.

Still another possibility is the sharing of computing power with other colleges and universities - either by establishing a joint on-campus facility on a time-shared and/or remote batch basis or by buying surplus computing power from a neighboring computer-rich institution at non-peak hours. Sharing of computing power via regional networks (whether remote batch, time-shared or intelligent terminal) has special significance for smaller (with enrollments less than 2500) colleges with no doctoral programs - institutions that number about 2.500 today. As Weeg(266) has pointed out, probably underlying the computing need of these institutions is the need for limited raw batch processing capability without any excessive capital investments. A deliberately designed non-profit cooperative effort could further reduce the computing charges than those available through service bureaus or commercial time-sharing service. One of the best known of such cooperative efforts in the United States is the "Triangle Universities Computation Center," a computer facility serving North Carolina State, Duke, and the University of North Carolina, as well as a number of smaller colleges in the state.(267, 268) Its experience seems to indicate that cooperative facilities may be an important alternative to the situation in which each institution provides its own on-campus facility. Further information on the more than 25 regional computing networks developed under NSF sponsorship is presented in Section IIC and Refs. 69 and 70.

Computer utilization in education is likely to continue to grow in terms of institutions having access to it and time available to individual students, as well as in terms of applications. The growth rate will be a function of developments in computer technology, reduction in computation cost, the money supply, and the extent to which emphasis is placed upon providing equitable access to all students irrespective of where they are located. So-called "supercomputers" such as CDC STAR and Illiac IV hold special promise for educational users in the coming decade. Remote computing networks based on supercomputers not only promise economies of scale and specialization but also are capable of providing a large selection of languages and systems that no ordinary institution could afford in a campus facility. The future of remote computing networks appears to be definitely bright in situations where the basic need is the delivery of raw computing power (a great deal of power but for relatively few applications) and not enough to justify dedicated campus-based facilities. The development of distributed networks also is foreseen where campus or regional computing centers would be connected among themselves.

Though large centralized computer facilities that are shared by many educational institutions are likely to continue to develop, both in numbers and capabilities, the development of small, cheap minicomputers and their application to education should not be ignored. Minicomputers are readily distinguishable from larger computer systems by their shorter word length, smaller size, limited processing capabilities, and significantly lower prices. A large number of minicomputers are available with varying capabilities.(269) Minicomputers can be particularly useful for real-time control of experiments and computation situations where the application is repetitive and the computer and software can be dedicated to a few tasks. Minicomputers can also be useful in the teaching of computer programming, certain kinds of Computer Assisted Instruction that involve little use of floating-point computations and problem solving situations that are not very taxing on the CPU--applications that are more inclined towards indexing, branching and logical operations.

As Levien(270) has pointed out, the use of minicomputers for instruction could promote the developments of instructional packages in cassette form that could be sold or rented like books or records. To some extent, this mode of providing "limited" computational facilities directly competes with the development of large, centralized computing centers that provide time-sharing and/or remote batch processing. However, although low in hardware cost, they require certain operational (management and programming) expenses that may not be insubstantial and which are shared by a large number of users in the case of large multi-access facilities. The final choice at the institutional or departmental level would depend upon the amount and nature of computing to be performed, and special requirements such as privacy, reliability and responsiveness.

Interconnection of computing centers themselves will offer network members access to all specialized facilities - both hardware and software - located throughout the network. Another approach to computer network development may involve small, local computers for most needs, but with the capability of tying-in with larger, remote computers when required. This involves a blend of several features - mini-computers, supercomputers, time-sharing, remote batch, and communications - and, in the future, may well be a common way of organizing and distributing computing power. Such an approach promises not only access to specialized hardware and software that may be prohibitive to develop at each individual location but also provides for the possibility of sharing the load with the remote computer during peak hours.

3. Computer Communications

Figures 38 and 39 illustrate two alternative ways in which computing networks may be arranged. In centralized computing networks (Figure 38), actual computing and maintenance for all users, whether simultaneous or one at a time, are carried out at a centralized location although access to the computer and to data banks is available from remote locations in time-sharing and/or remote-batch mode. In decentralized or distributed computer networks(271) the data processing activity is carried out by several installations (Figure 39). An essential difference between the two forms of information network is the existence of two forms of communications traffic in the distributed

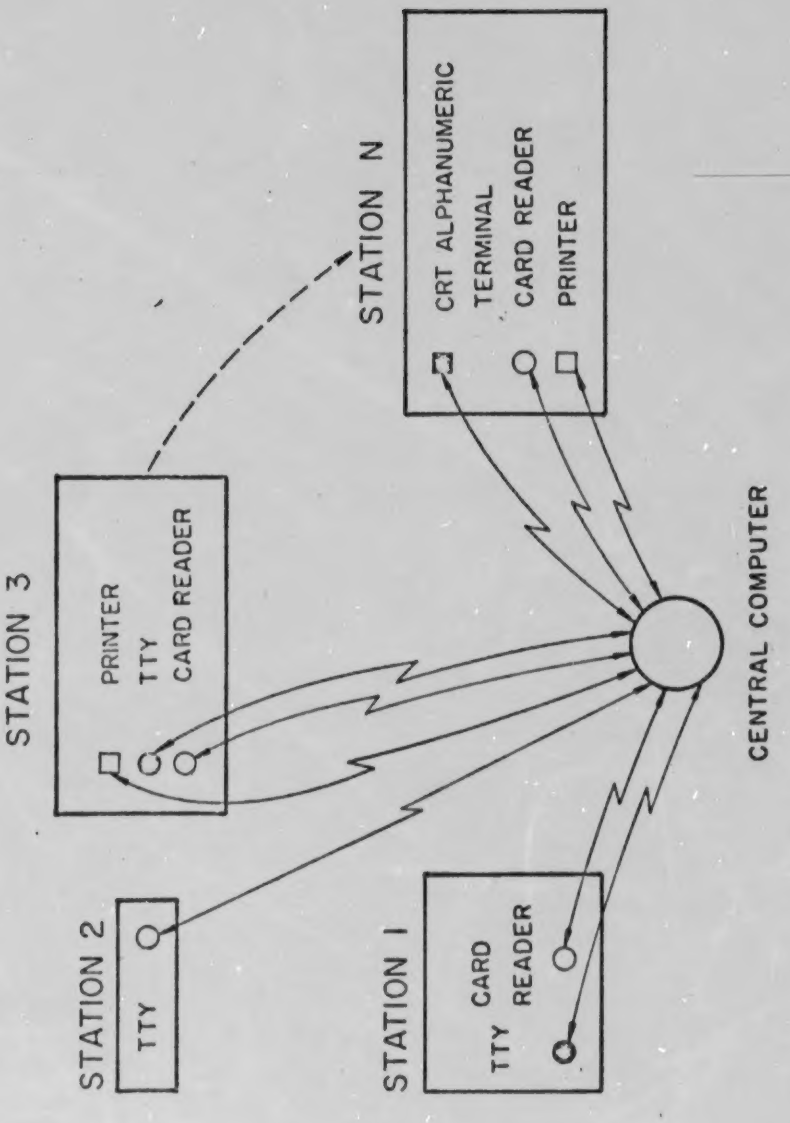
STATION 2
TTY
STATION I
TTY
CARD READER
STATION 3
PRINTER
TTY
CARD READER
STATION N
CRT ALPHANUMERIC TERMINAL
CARD READER
PRINTER
CENTRAL COMPUTER

FIGURE 38. CENTRALIZED COMPUTING NETWORK

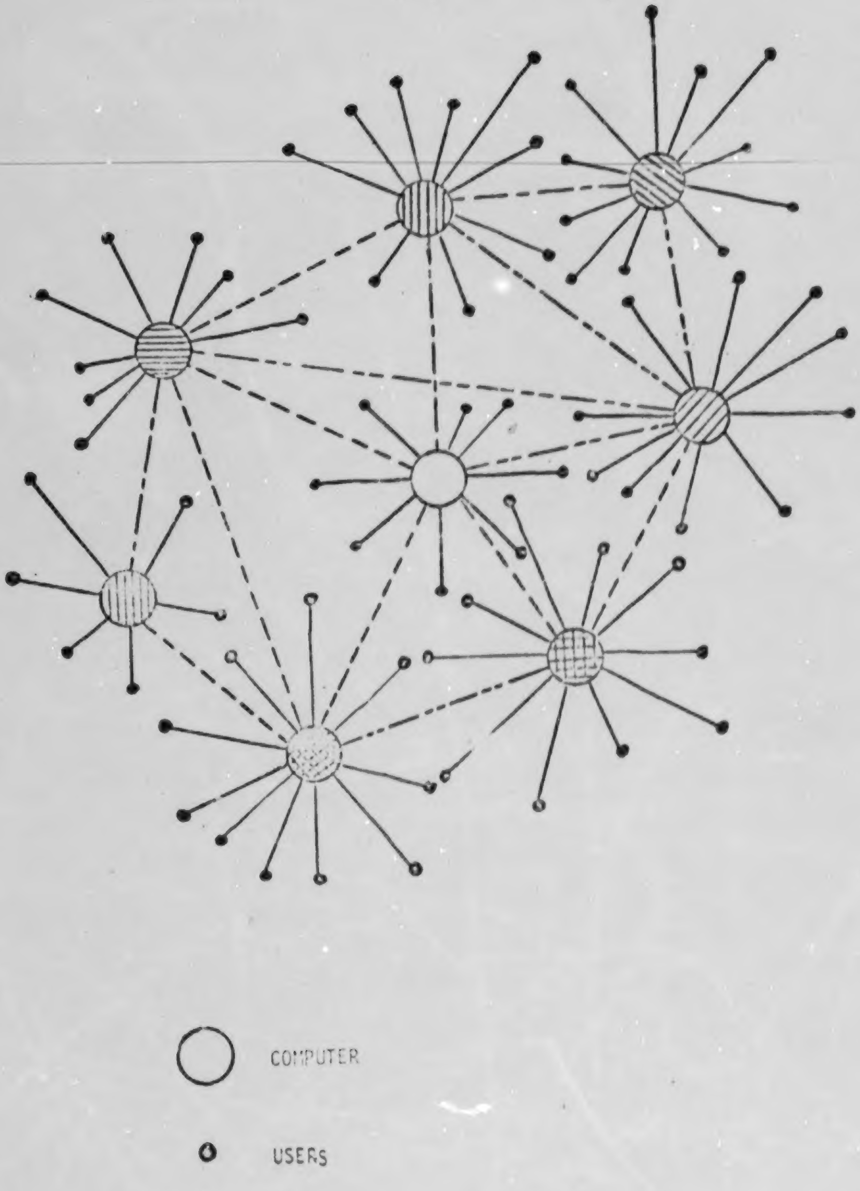
COMPUTER
USERS

Figure 39. Decentralized or Distributed Computing Network

configuration. As in the centralized configuration, there are communications between remote terminals and an individual computer installation close by. However, there are in addition, the communications between the nodes or computer installations of the network. A distributed network offers not only the benefits of economies of scale that are also available through centralized networks, but also the economies and advantages of specialization - specialized software, hardware, and data bases.

Both types of computing networks can be implemented either on an intra- or inter-institutional basis. For example, a large institution could have its own centralized facility offering both time-sharing and remote batch services at various locations within its campus or various campuses like the Regional Computing Facility in the State University of New York(272), or several institutions could establish a joint facility like "Triangle Universities Computation Center" in North Carolina.(268) Similarly, a large and computer-rich institution like MIT may very well implement a distributed computer network within the institute itself by interconnecting its various computers located at different geographical locations within the institute.(273) In the case of the ARPA network(274) and the Princeton-Carnegie Mellon-IBM network(275), computing facilities belonging to a number of educational and/or research institutions could be interconnected to permit resource sharing.

Distributed networks hold special promises for load sharing and specialized applications, particularly those related to research. However, the computation task must be sufficiently long or urgent so that the payoff in reduced charges for computation (due to the use of a specialized facility) or the gains obtained from a quicker processing, balance the extra communication expense involved in transmitting the data pertaining to the job from the user's regular computer facility to another distant facility and receiving back the results. A major problem in the implementation of distributed networks today is that the computers in use in educational institutions differ from one another in type, size, speed, word length, operating systems, etc. in a large number of cases, and any interconnection of these heterogeneous modes requires an additional expense in terms of small "interface" computers for adequate compatibility conversions.

It seems likely that between centralized and distributed network services, it will be the centralized networks whose development will dominate the early years of network development. Both specialized and general purpose facilities would play an important role in extending the computer services and various applications to small colleges, elementary and secondary schools which lack adequate financial resources to own and operate their own facilities. Specialized educational centralized computer networks will be oriented towards storage and retrieval of specialized data - data relating to elementary particles, nuclear physics and engineering, thermodynamics, transport properties, chemical kinetics, solid state, and atomic and molecular properties, life sciences and medicine, etc. - many of which are being maintained at several dispersed locations by various government and non-government agencies.(276) In addition, special centralized networks for educational administrative applications, personnel management and educational planning also have good prospects for development.

The pressure behind the development of these networks would primarily be economic. The dedicated educational computer networks could either be a deliberately designed non-profit cooperative effort among schools, school districts, colleges and universities in a particular region, or could be the extension of a computer-rich institution's computer facility - an institution that wants to generate additional revenues to support its computation activities at a time when NSF institutional computer facilities program has been phased out, educational discounts for computer hardware are gradually fading away, and the budget for the computing facility is consuming an appreciable and increasing portion of the institutional regular budget that itself is facing severe hardships. Perhaps in the early years of network development, several network options will be available for the users in each geographical region. However, in view of the current telecommunication plant's inadequacy for data-transmission and the incompatibility among the various computer systems manufactured by different companies, it seems unlikely that for some time, users with a particular remote terminal designed for operation with a particular computer system, would be able to access the network of their desire on a "switched" or "dial-up" basis. Most of the user-computer interconnection would be through private, leased, and, in many instances, through specially conditioned lines.

Figure 40 depicts one possible scenario for the evolution of distributed networks from centralized networks over the course of time. For this to occur, necessary developments include the development of less expensive means of data transmission and some standardization of computer systems. In addition, educational users will have to become convinced that the benefits outweigh the costs involved.

Prior to the advent of the communications satellite, prospective users of communications channels for computer communications could obtain

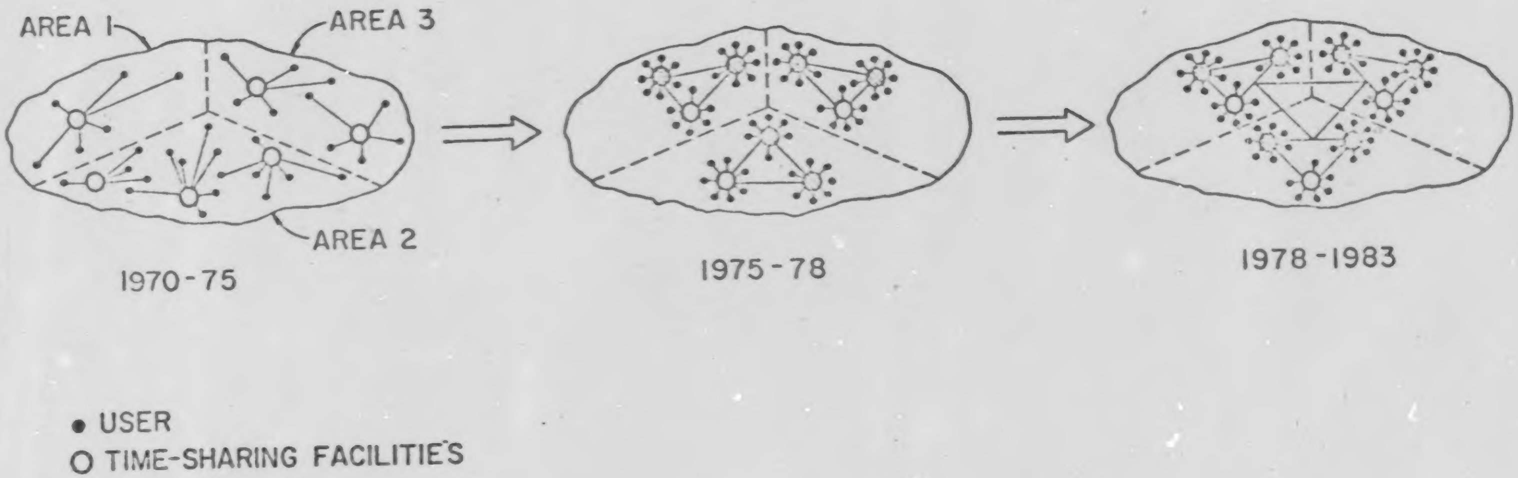
AREA 1
AREA 3
AREA 2
1970-75
1975-78
1978-1983
● USER
○ TIME-SHARING FACILITIES

FIGURE 40. EVOLUTION OF DISTRIBUTED NETWORKS

network facilities from three sources: AT&T, specialized common carriers such as MCI and DATRAN, and Western Union.* Some of the inadequacies of the ground based telecommunications plant for digital data distribution are discussed in some detail in Ref. 11 and in more detail elsewhere.(277, 278) Seven areas cited in a 1969 SRI report where improvement is needed in the existing plant include:

a) A need for rapid connect and disconnect (a few tenths of a second)

b) A need for greater variety of transmission speeds and bandwidths

c) A need for switched duplex connections, i.e., independent, separate paths for the two directions of transmission, in voice grade circuits

d) A need for the availability of different data speeds in the two directions of transmission

e) A need to reduce error rates

f) A need for reduction in variability of transmission performance in the public switched network

g) A need for an all-digital data transmission network.

A major area of concern to educational users is the current cost of communication. The cost of a telephone line appears to have been constant over the past decade, while the cost of computers has been dropping at about 25 percent per year. If this trend continues, eventually the communication cost may become the dominant cost component of most teleprocessing systems.

The cost of an educational telecommunications system as a whole can be expressed as the sum of the costs of the four elements:

$$\text{Total cost} = \begin{bmatrix}\text{Cost of}\\ \text{Computers}\end{bmatrix} + \begin{bmatrix}\text{Cost of}\\ \text{User Terminals}\end{bmatrix} + \begin{bmatrix}\text{Cost of}\\ \text{Software}\end{bmatrix} + \begin{bmatrix}\text{Cost of Data Trans-}\\ \text{mission \& Switching}\end{bmatrix}$$

---

*which has been predominantly dependent upon AT&T facilities until the launching of the Westar domestic satellite.

Zeidler et al. have studied the patterns of technology in Data Processing and Data Communications(277) and have found approximately 25 percent annual decrease in the computation costs. According to them, a continued decrease in cost per computer function required of the central processing unit (CPU) is expected primarily due to the advances in the state of the art in Integrated Circuit technology, basic systems design and the development of Large Scale Integration. Decrease in the cost of communication control terminals and regular conversational terminals is also expected to continue, and so is the cost of software (measured in cost per phrase). However, some caution must be interjected at this point. There is a counter trend that affects the probable cost of a teleprocessing system for a given job - the tendency of the users to want systems to be made easier to use which requires additional complex hardware as well as more complex software. System cost for a given function tends to fall less rapidly than the cost of a computation for this reason. Also, as communication costs rise as a percentage of the total cost, minimum total system cost can often be realized with more expensive computers and terminals that do more processing of the information before transmitting it. The net result is that annual cost reduction for the noncommunications component of teleprocessing systems is lower than 25 percent cost reductions in the cost of computing (measured in terms of a basic function operation in CPU). However, even 10 or 15 percent per year cost reduction is large in comparison for what is projected for communications lines.

The SRI study(277) has projected a small decrease in the communication costs for the 1970's. This combined with the fact that cost of a telephone line has been very much constant over the last decade are quite surprising when one considers the advances in terrestrial microwave, coaxial line, millimeters waveguides, and satellite communications that have taken place. The fact is that such long-haul systems have indeed dropped the long-haul portion of the telephone line cost and further reductions are expected. But the problem is the local telephone plant and associated switching system that account for over 80 percent of the cost, of even long-distance calls.(279) There is very little prospect for any significant cost reduction here. This necessitates exploration of communications systems/techniques that bypass the existing local telephone plant and associated switching equipment. This is exactly what the newly developing specialized data-transmission/business oriented carriers like DATRAN and MCI are looking forward to. It also represents an opportunity for satellite utilization.

4. Satellites and Computer Communications

An examination of existing telecommunications plant and costs reveals that, unless communications costs are significantly lowered, they could become the most expensive part of large-scale computing networks and long-distance information transfer. The cost of a telephone line appears to have been roughly constant over the past decade whereas the cost of computers has been dropping at about 25%/yr. This may seem surprising in view of advances in such technologies as cable, millimeter waveguides, microwave, etc. However, the problem is that over 80% of the telecommunications cost is in the local telephone plant and associated switching equipment. New, specialized common carriers such as DATRAN and MCI offer possibilities for economies in this regard.(11)

Communications satellites offer certain advantages for interactive multiaccess computing and remote batch processing provided that the local telephone switching plant can be bypassed. Small earth terminals co-located at the computing facilities and shared with other services such as ITV can be designed to avoid the high error rates associated with existing switching equipment. Essential cost-benefit analyses remain to be performed.

Because of the link length of the synchronous satellite systems, at least 0.5 sec is inherent delay in such systems. Various schemes have been proposed to minimize the effects of this delay.(11) If the system is such that the user must wait for 1.0 sec until his keyed-in response appears on a display terminal, as would be the case in the current Plato-type system, the delay is believed to be intolerable. However, other systems or modifications of existing systems in which such centralized character echoing is not intrinsic would appear to be pefectly feasible.

Primary roles for satellites are expected to be towards the delivery of computing power to remote and small institutions and interconnection of computing facilities separated by substantial distances. (See Table 6.) The minimum distances for which satellite interconnection becomes economically viable is a function of the satellite and Earth-terminal characteristics, data transmission rates involved, total terminal population, and average cluster population.(11)

Any arrangement that bypasses the local telephone switching plant allows users to employ the full capabilities of the high quality communication offered by the satellite. It has been estimated that a synchronous satellite communications circuit can provide error rates better than 1×10^{-7}

and as good as 1×10^{-10} for data transmission. In addition, it could provide a more flexible choice of channel widths to suite the individual requirements. However, if the access to the earth-terminal is accomplished using the currently available dial network with the associated switching equipment and channels more adapted for voice communications having an error rate of $1 \times 10^{-3} - 1 \times 10^{-4}$, the quality of the satellite part of the interconnection is of purely academic interest. The overall circuit performance cannot exceed the performance of the lowest quality component. From this viewpoint, small earth-terminals colocated at the computing facilities and shared with other kinds of satellite-based educational material delivery services such as ITV, offer an attractive alternative for computer communications. However, it should be kept in mind that a major component of the satellite-based communication circuit is attributable to the earth-terminal cost and its contribution to one particular service would depend upon what other services are sharing the same earth-terminal - services such as the delivery of ETV and ITV program material, teleconferencing, etc.

The basic networking requirements for interactive multi-access computing can be classified as multipoint-to-point and point-to-multipoint with asymmetrical channel capacities in two directions (computer to user and user to computer) whereas those for computer interconnection can be categorized as point-to-point. The requirements for remote batch processing are similar to that of interactive multi-access computing except for the fact that interaction takes place at relatively higher speeds and the channel capacity requirements are not necessarily asymmetrical. A single relay and switching station in the sky, a satellite, overlooking a large area on the earth, has certain advantages for this kind of networking and offers distinct flexibilities in terms of geographical rearrangement of the interactive-terminal clusters and/or remote batch terminals and computers provided the terminals for communication with the satellite are colocated with the terminal clusters and/or computers.

Singh and Morgan in a 1971 report considered two possibilities for an operational satellite-based computer-communication system,(11) namely:

(a) A relatively high-power (55-60 dBW e.i.r.p.) dedicated educational satellite capable of small earth-terminal operation

(b) Commercial satellite systems that may be authorized by the FCC.

At the present time, satellites in the second category are coming into being. In general, there are several major deficiencies associated with these satellites as far as educational networking is concerned, including 1) low-power transponders necessitating use of costly earth terminals and costly ground distribution facilities, 2) use of 4- and 6-GHz frequency bands which severely restricts the colocation of earth terminals with urban operations and redistribution centers, and 3) relatively few receive/transmit earth stations which complicates the problem of liberalized access.(5, 11) The other line of development, namely the high powered satellite for education purposes, is currently in danger of being cut off (see Section IIC4e) A more detailed analysis of tradeoffs between low and high power satellites for computer communications is presented in Ref. (11).

G. INFORMATION RESOURCE SHARING

1. Introduction

In a sense, the activities discussed previously in Section F might be classified as "information resource sharing." However, there are a large number of other activities in which information may be shared among institutions and users. These include activities in which university, college and school libraries share resources in some centralized or distributed configuration. Other cases of information resource sharing might include computerized vocational guidance systems (see Section IID), data banks such as that being developed by The New York Times, regional systems for specialized science and medical information (see Section IIC) and educational information systems to aid in educational administration.

In this section, primary attention will be devoted to utilization of telecommunications by libraries. Several such activities involving communications satellites will be discussed. Some of what follows is excerpted from a 1971-72 study by Niehaus.(12) Also included is a brief discussion of educational information systems.

2. Utilization of Telecommunications by Academic and School Libraries*

A study was carried out(12) in 1971-72 of utilization of telecommunications by university, college, and school libraries in the United States. In fiscal year 1968, for 45.3 million public and private school pupils (92% of those eligible) a total of $171.4 million was spent for school library resources, of which $82.2 million was provided by ESEA Title II. Academic library operating expenditures have risen over threefold in the 1960's to an estimated $600 million for 1970-71. Expenditures per student rose from $47.13 in 1961-62 to an estimated $73.17 for 1970-71. Library expenditures as a percentage of total educational expenditures have climbed at a slower rate from 3.1% to 3.8% over the same period.

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*Detailed references for this section may be found in Ref. 12.

Federal funds have been perhaps the single greatest stimulant to the utilization of telecommunication by libraries. In addition to ESEA Title II already mentioned, ESEA (Title III) and the Higher Education Act (Title II-A - Special Purpose Grants) encourage the use of communication by offering grants for innovative cooperative programs and to establish and strengthen joint-use facilities. Not all of the libraries supported by this legislation will employ telecommunications, but the potential to do so is great. Title IX (Networks for Knowledge) was added to the Higher Education Act of 1968 with provision for support of cooperative exploration of new computer and communication technologies among institutions of higher learning. However, this program has never been funded. Title III (Interlibrary Cooperation) of the Library Services and Construction Act (LSCA) of 1966 has aided in the creation of 35 telecommunications networks connecting 800 libraries.

Teleprinters are by far the most common means of telecommunications used by libraries. Teletype service is supported by either switched networks or leased lines. The teletype switched network (TWX) is operated by Western Union. Approximately 6.5% and 8.6% of all academic libraries in the U.S. were TWX subscribers in 1968 and 1970-71, respectively. Wide Area Telephone Service (WATS) is in general use but telefacsimile is currently (1971) used only sparingly because of one or more of the following: 1) high cost (in excess of $1/page), 2) poor quality copy, 3) long transmission time, 4) low volume demand, and 5) for fast service, terminal equipment which cannot copy from bound volumes. Broadcast TV is expensive for library use. CATV has been used to provide a video reference service. With the growth of two-way communications via cable, libraries could use CATV for facsimile reproductions, information retrieval, and other purposes.

In a paper presented at the Conference on Inter-Library Communications and Information Networks in October, 1970, John Bystrom summarized the prospects for future utilization:(279)

> "There is as yet no library strategy for the development and use of statewide telecommunication systems and urban cable systems or for international exchange by satellite. The use to which libraries will put these telecommunication systems is a matter of conjecture."

A major thrust towards use of telecommunications in education is coming from the field of medicine. The development of Medline and associated trends favor the use of networking. Library data processing, both in medical and other fields, requires large computers for the bibliographic, cataloging, abstracting and other functions to be performed. Resource sharing therefore becomes an important possibility. Thus telecommunications, including satellite networking, could play an increasingly important role, particularly in higher education associated with medical education. The Lister Hill Center at the National Library of Medicine (NLM) has already sponsored a demonstration of the utility of satellite communications by means of NASA's Applications Technology Satellite I linking the National Library of Medicine, the University of Alaska, the University of Wisconsin, and Stanford University. For non-medical applications, a network has been developed to provide on-line shared cataloging services for 48 colleges and libraries in Ohio by the Ohio College Library Center and is being extended to other states.

Although Niehaus concluded in 1972 that most library telecommunications projects were experimental and detailed plans for operational library telecommunications systems were virtually non-existent, interest in telecommunications use by libraries has persisted. A relatively new newsletter, "Cable Libraries," contains monthly information on library activities involving technology, telecommunications and libraries. The May, 1974 issue describes the Library Satellite Project, sponsored by the Alaska Library Association and supported in part by the Alaska State Library, which uses the ATS-1 satellite and is planning to use ATS-6.(280)

3. The "SALINET" and "Facsimile Network" CTS Experiments

In this section two experiments are described which have won conditional approval* from NASA for implementation on the joint U.S.-Canada Communications Technology Satellite (CTS) to be launched in December, 1975. These descriptions provide some insight into the possibilities inherent in information resource sharing via satellite.

"SALINET" stands for Satellite Library Information Network, involving the University of Denver Graduate School of Librarianship, the University of Kansas Libraries, the Wyoming State Library and the Natrona County (Wyoming) Library. According to a press release dated April 19, 1974,(281) the program will also involve the Bibliographical Center for Research of the Rocky Mountain Region, Inc., the Federation of Rocky Mountain States, and the Mountain-Plains Library Association (see Figure 41). "The proposed program will utilize 56 satellite ground stations already in place as part of

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*Approval is contingent upon future acquisition of funding from sources other than NASA.

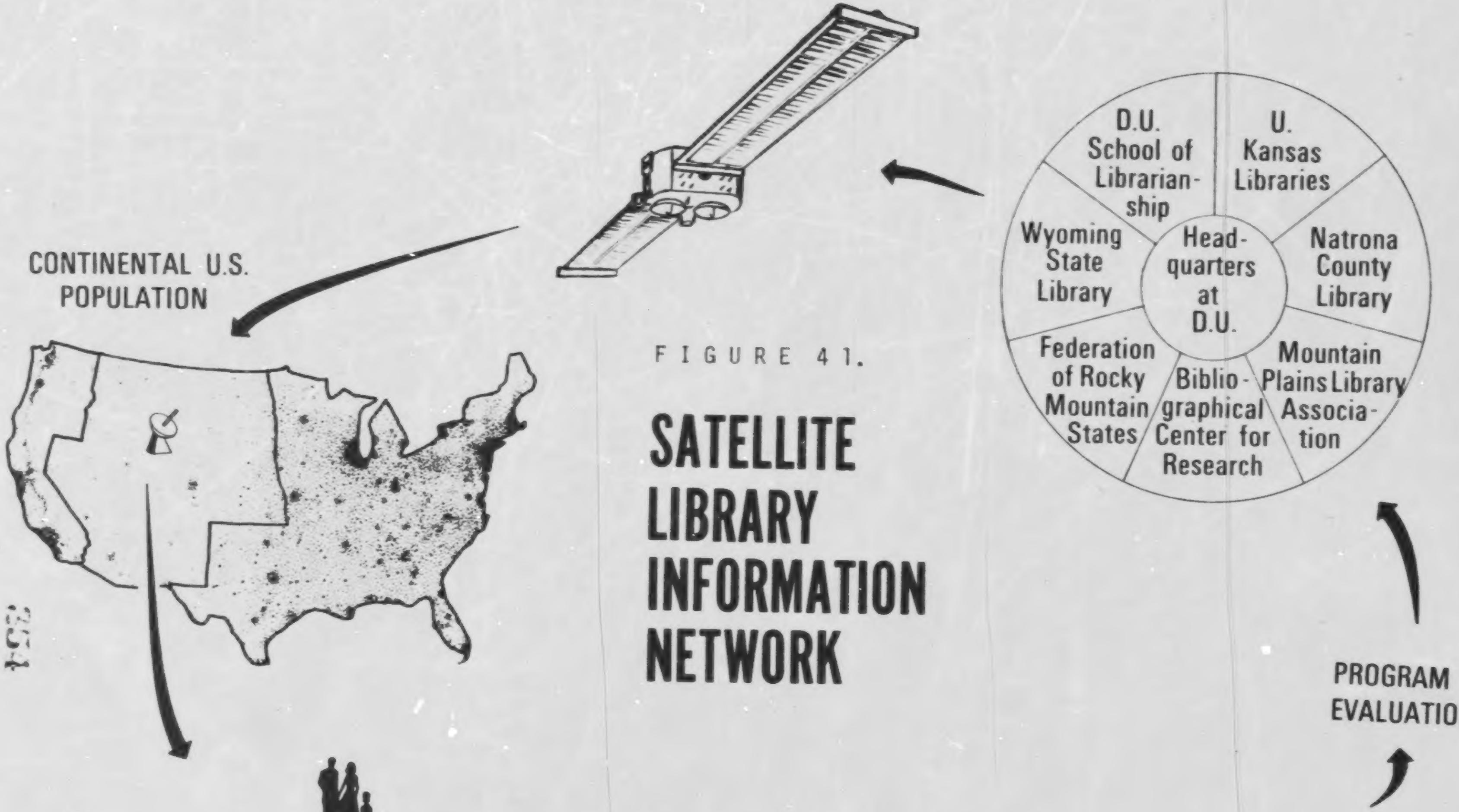
CONTINENTAL U.S. POPULATION
D.U. School of Librarianship
U. Kansas Libraries
Natrona County Library
Mountain Plains Library Association
Bibliographical Center for Research
Federation of Rocky Mountain States
Wyoming State Library
Headquarters at D.U.
PROGRAM EVALUATION

FIGURE 41.

SATELLITE LIBRARY INFORMATION NETWORK

- Strategies for satisfying information needs of individuals.
- Information on critical problems facing town and municipal officials and businesses.
- In-service training for library staffs.
- Compressed bibliographic data from U. of Kansas to resource centers in the region.

the Federation's involvement in satellite technology demonstrations.* (See Section IIC.) Twenty participating libraries in the states of North and South Dakota, Nebraska and Kansas will be added to complete a 12-state test bed representing all categories of libraries."(281)

The primary goals of the library information network are stated to be as follows:(281)

a) To improve individual and organizational capacities for getting information.

b) To demonstrate and test cost effectiveness in using technological advances to disseminate information.

c) To develop user "markets" for information utilizing satellite distribution.

Among the activities to be undertaken are public information programming at the individual level, technology dissemination at the community level, compressed bibliographical data transmissions, and in-service training of librarians both at the professional and paraprofessional level. Resource sharing will permit remote libraries to have access to information about resources available from large and specialized centers, such as the Denver Public Library's special conservation library or Western History collection.(281)

Another CTS experiment with conditional approval involves operation of a satellite-linked prototype facsimile (fax) network by the New York State Library and interconnecting seven regional networks centered in places as scattered as Juneau, Alaska; Los Angeles, California; Springfield, Illinois;

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*The Federation of Rocky Mountain States is a key organization in satellite experiments, being heavily involved in ATS-6 and an educational as well as library follow-on on CTS. It should be remembered that ground receivers will have to be modified for use with CTS after ATS-6 because of different operating frequencies.

and Albany, New York.(282) In this experiment pages will be copied and transmitted electronically, with the satellites being used for long-distance portions of the network. Facsimile equipment must be capable of transmitting pages directly from bound library volumes.

The facsimile network experiment will primarily serve researchers in several fields, legislators and businessmen with interconnections to both the Library of Congress and the National Library of Medicine. The projected daily rate of transmission via the pilot network is 450 pages.(282) Time for satellite utilization in this and the SALINET experiment is limited by the needs of other investigators both in the U.S. and Canada involved in CTS.

4. Educational Information Systems

Recently some educational researchers and planners at the Rand Corporation have put forward the concept of an Educational Information System (EIS) modeled along the lines of Management Information Systems (MIS) for improving the administrative operations and performance of the schools and teachers and making student and teacher performance data readily available for the purposes of accountability and evaluation of the educational process.(268,283,284)

Although no EIS systems exist today in the exact sense that these planners have envisioned, a number of educational data systems provide some of the services similar to that of EIS. Coleman et al.(263) have presented a 1970 survey of ten such systems. Of the ten systems surveyed, nine of them are implemented on an inter-school basis at the county and state levels. Only one is designed to serve a particular school. Of the nine that have been implemented on an inter-school basis, four are supported by TITLE III USOE funds and three by the Ford Foundation. The largest system belongs to the counties of Macomb, Oakland and Wayne in Michigan and serves some 1,150,000 school children in 93 schools. California seems to be developing a statewide system to serve a potential student population of 2,031,400 in elementary schools and 1,066,529 in secondary schools; however, as of 1970 the actual student population for which information was computerized was 86,000 in elementary schools (4.2%) and 308,000 (28.9%) in secondary schools.

California Total Education Information System is an outgrowth of a pilot project that was conducted in 1960-63 by the Richmond City schools under an NDEA Title V grant aimed at providing integrated data processing in the State of California. The Richmond City schools project was principally a feasibility study involving field testing of a pupil personnel package in five school districts. The conclusions drawn were that "many districts, many schools, and many educators can get together and work out a successful data processing system. They can develop applications that are not only feasible and workable but really efficient...."(285) A 1968 report indicates that thirteen regional centers located at Ventura, Sacramento, Fresno, Kern, San Mateo, Contra Costa, Sonoma, San Francisco, Santa Clara, Riverside, San Diego and Los Angeles provide pupil personnel packages to participating schools. The functions of the package include scheduling, attendance accounting, grade reporting, standardized test reporting, guidance counseling, and master file maintenance.(286) The range of prices charged by the regional centers to local districts for pupil personnel packages is given in the table below.(286) (Prices are on a per student basis.)

Secondary		Elementary	
1967-68	1968-69	1967-68	1968-69
$2.50-4.00	$2.90-4.67	$1.00-1.50	$1.25-1.75

In Franklin County (Columbus, Ohio), a similar Total Information Center charged its participating schools for similar services at a rate of $1.00 per elementary school student, $1.50 per junior high school student, and $2.00 for every senior high school student.

Coleman and Karweit,(263) Clayton,(283) and Blackwell et al.,(284) all of RAND Corporation, have presented the arguments for bringing about the incorporation of computers in education, primarily at the school level, for storing, manipulating, and retrieving information to meet the information needs of the school systems. The authors feel that such administrative applications hold greater promise for the introduction of computers in schools in near-term future than applications oriented towards providing instruction. The prospects for widespread adoption of computer-based total information systems in education are enhanced particularly at a time when the demands for accountability in education are getting stronger and the introduction of curricular changes and attempts at new organizational patterns are placing heavy demands on collecting data and evaluating the effectiveness of programs. Figure 42 presents the flow of information between the various levels that will be involved in multilevel information systems for education.

The development of Educational Information Systems (EIS), such as those in Michigan, California, and Iowa, could create a sizeable demand for computer-resource sharing at the school level. These systems are essentially management information systems for education to aid in making decisions regarding financial and academic policy. Although this particular report does not contain an assessment of the potential impacts of large-scale educational telecommunications systems, the authors wish to point out that privacy is an

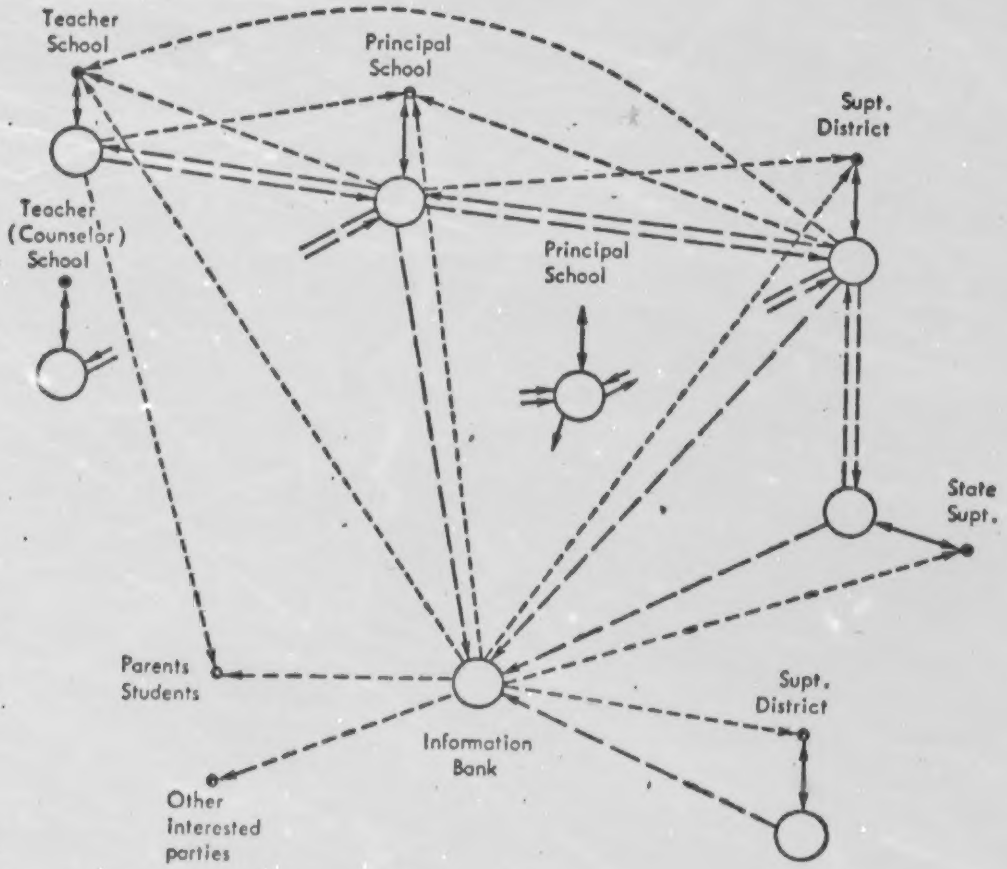
Teacher
School
Principal
School
Supt.
District
Teacher
(Counselor)
School
Principal
School
State
Supt.
Parents
Students
Supt.
District
Information
Bank
Other
interested
parties

Figure 42. Information Flow in Multi-level·Information Systems For Education [Ref. 263]

impact which requires careful consideration in connection with the spread of educational information systems. Lieberman and Morgan(287) have studied privacy aspects of such systems which tend to collect a wide variety of information, some highly personal about individuals.* Information collected may provide answers to such questions as how many teachers are receiving at least a $10,000 salary; how well are sixth grade students doing who attended one district kindergarten versus another; how well are black students doing versus white students.

The key questions to be answered in connection with privacy and educational information systems include: 1) What information is to be collected? 2) Who is to have access to that information? 3) How will unauthorized access to that information be prevented?(287) Recently legislation was passed which requires that schools make student files accessible to the parents of students. The impact of this legislation and the increasing concern over privacy in the U.S. may have a significant effect on the future development of educational information systems and on the practices of current systems.

3. Postscript

In this chapter, we have presented selected information about several educational telecommunications services which could be potentially important elements of large-scale educational telecommunications systems. No attempt was made either to treat these services in exhaustive detail or to consider all possible services. Additional information can be found in connection with the analyses of specific educational subsectors in Chapter II and in several source documents developed in the course of this study.(8, 9, 10, 11, 12)

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*Not all the information in these systems concerns students. Some concerns building size and facilities, supplies, finances, etc. (287)

IV. FORECASTING FUTURE EDUCATIONAL TELECOMMUNICATIONS AND SATELLITE UTILIZATION

A. INTRODUCTION

This chapter summarizes efforts to forecast future educational telecommunications and satellite utilization over the next ten to fifteen years. First, previous forecasts by other organizations will be briefly reviewed. Then, two separate forecasting attempts performed in connection with this study will be presented. The first of these represents an effort to forecast future utilization essentially by making "educated guesstimates" based upon a detailed series of background analyses which have been summarized in Chapter III. The second of these employed the Delphi method, and was concerned with forecasting the use of technology in education without specific reference to satellite utilization. The latter study also probes values and opinions which may affect educational technology utilization in the year 1990.

1. Review of Previous Studies

Prior to initiation of our research, very few efforts had been made to predict future use of technology in education in general and satellite utilization in particular. Such efforts were generally NASA supported and concerned with developing the educational requirements of new satellite technology or experiments along with requirements for other applications. They include an early study by Lockheed Missile and Space Co.(288) which provides estimates of long-haul requirements for information transfer in education through 1985, and is based heavily on extrapolation from past trends. A more recent Lockheed study of Technology Requirements for Post-1985 Communications Satellites relies in part upon results to be presented in Section IVB.

and was completed in October 1973.(284) A study of educational requirements for the Space Shuttle has been carried out at the University of Alabama, Huntsville.

The difficulties in forecasting future educational telecommunications and satellite utilization at this point in time are acute, and the reader should be aware of this at the outset. If one specifies large-scale telecommunications system requirements for instructional television or computer-based instruction, it must be kept in mind that current utilization of these technologies is minimal at best. To bring large-scale utilization into being may require certain structural changes in education which may not come about. Furthermore, large-scale utilization is bound to have certain socio-economic consequences. For satellites in particular, much may hinge upon the success or failure of the ATS-6 HET experiment now underway and upon the extent to which financial and other resources are made available by government in the future.

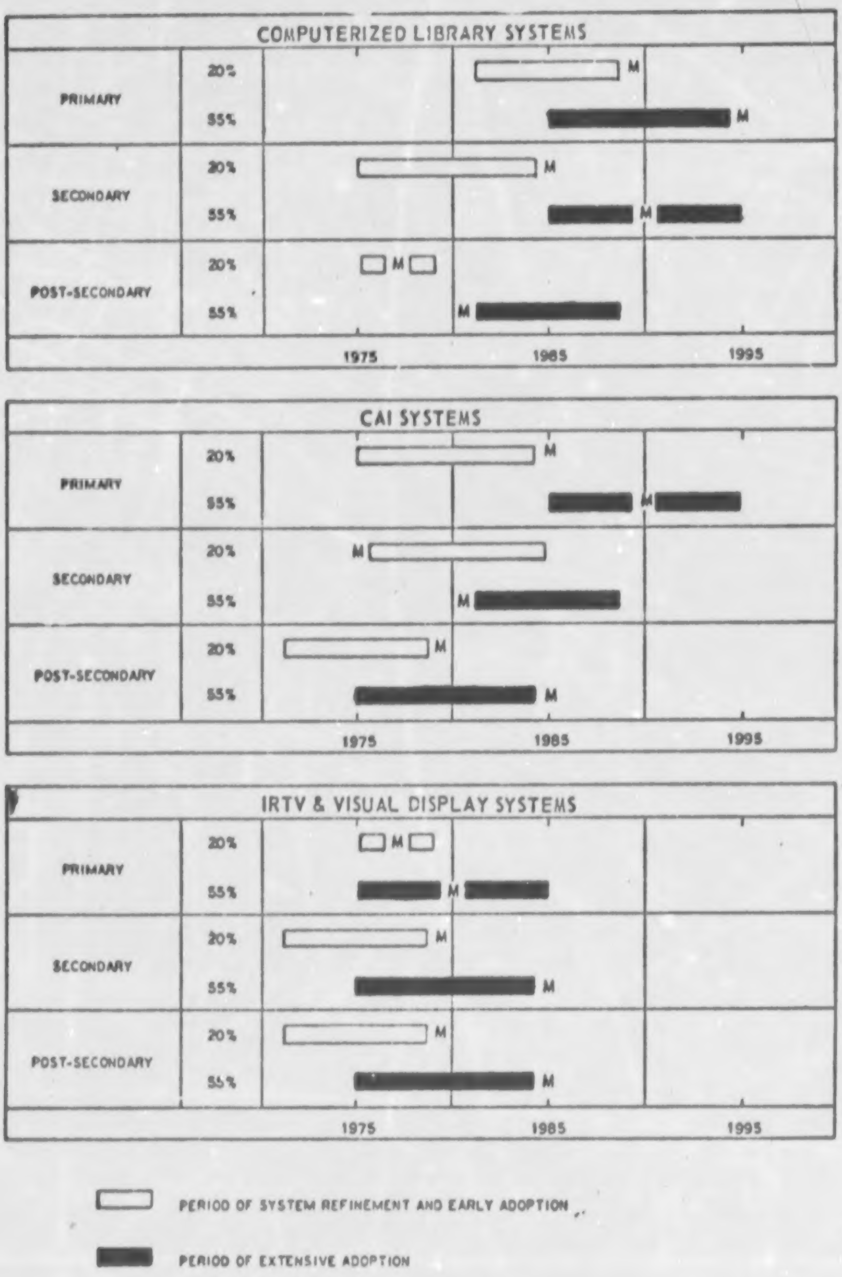
If one views the satellite as one possible delivery mode for a variety of educational telecommunications services, then the degree of satellite utilization may depend in part upon future acceptance of technology in education in general. An interdisciplinary group at Bell-Canada has carried out a study, entitled "An Exploration of the Future in Educational Technology," which utilized the Delphi Technique to predict when various educational technologies will come into certain quantitative levels of use at several levels of education. The technologies considered included computer-aided instruction (CAI), information retrieval-computerized library systems (CLS), audio-visual display devices (informational retrieval television systems), terminals for CAI, and/or CLS. The diffusion of educational technology into the home also was examined.

A major conclusion of the Bell-Canada study is that "extensive development and widespread adoption of educational technology will occur during the late seventies and eighties." (See Figure 43.) The conclusion is one of three major trends gleaned from the study. The other two are: "A period of change in education is forecasted during which concepts, curricula, methods and the role of the teacher in the educational process will alter steadily over the next twenty-five years." "The whole society will be in a period of transition. Cultural values will be changing gradually to form a society more open to innovation, more insistent upon involvement and participation, and more oriented to the individual."(290) Members of the Bell-Canada Study Team were primarily educational researchers, administrators, consultants and technologists. In general, we feel that the Bell-Canada study results may be overly optimistic concerning the acceptance of educational technology.

Other studies which provide limited information concerning future utilization include a 1969 National Academy of Engineering study,(291) a Carnegie Commission supported study,(60) and an EDUCOM study.(55) All of these concentrated primarily on higher education.

Figure 43.

LIKELY TIMING OF ADOPTION OF TECHNOLOGICAL SYSTEMS*



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*From Bell-Canada Delphi Study (290)

B. ESTIMATES OF TECHNOLOGY UTILIZATION IN EDUCATION; 1975; 1985, WITH ESTIMATES OF POTENTIAL SATELLITE UTILIZATION*

Figure 44 (left-hand side) illustrates the procedure which was set forth to make estimates of satellite utilization ranges. The starting point is the background studies on various technologies and media which were summarized previously. Basically, "educated guesses" have been advanced of ranges of utilization of technology and media in education that might be possible in 1975 and 1985, based upon the background studies. These latter studies also provide useful information of direct value in satellite-systems synthesis work and in future socio-economic impact studies, as is depicted by the flows on the diagram leading to "Keys to Technology Utilization in Education" and "Keys to Satellite-Based Delivery and Networking."

In addition to estimating ranges of media-technology utilization, it is necessary to estimate what subset of this over-all utilization is likely to make potential use of satellite-based services. This latter set of estimates derives from a number of sources of information, as shown in Figure 44. The complexity of this type of analysis is illustrated by the fact that the desired estimates also will be affected by both an analysis of conditions for achieving various utilization levels and an analysis of the impact of these levels upon education.

Table 24 presents estimates of technology utilization in education for the years 1975 and 1985, together with estimates of the percentages of the total institutional population likely to make potential use of satellite-based services. The services for which estimates have been made fall into

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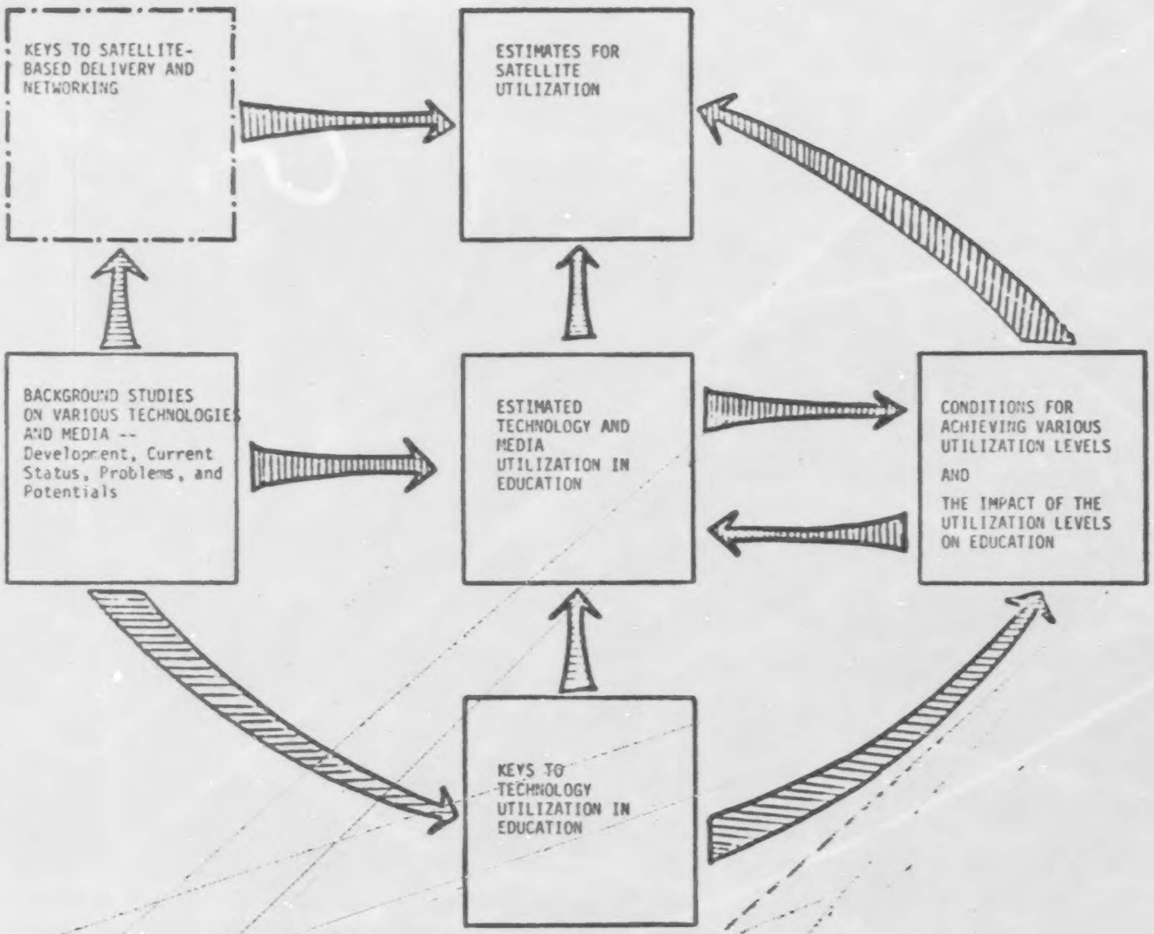
*The results of this section remain essentially unchanged from those originally presented in 1971. (4, 5)


KEYS TO SATELLITE-BASED DELIVERY AND NETWORKING
ESTIMATES FOR SATELLITE UTILIZATION
BACKGROUND STUDIES ON VARIOUS TECHNOLOGIES AND MEDIA -- Development, Current Status, Problems, and Potentials
ESTIMATED TECHNOLOGY AND MEDIA UTILIZATION IN EDUCATION
CONDITIONS FOR ACHIEVING VARIOUS UTILIZATION LEVELS
AND
THE IMPACT OF THE UTILIZATION LEVELS ON EDUCATION
KEYS TO TECHNOLOGY UTILIZATION IN EDUCATION

PROCEDURE FOR OBTAINING SATELLITE UTILIZATION ESTIMATES

Figure 44 (From Ref. (4))

Table 24: Estimates of technology utilization in education; 1975; 1985; with estimates of potential satellite utilization.*

Service		Percentage utilization						Primary roles for satellites	Percent of the potential user institutional population likely to make use of satellite-based services		
		1975			1985						
		Elementary education	Secondary education	Higher education	Elementary education	Secondary education	Higher education		Elementary education	Secondary education	Higher education
Instructional television (ITV)[a]		3-6	4-8	5-10	4-20	4-25	5-20	Direct delivery to schools; to broadcast stations, and ITFS and cable headends for further redistribution	40-90	40-90	20-50
Computer-aided instruction (CAI)[a]		0.1-2	0.3-2	1-3	1-10	5-20	5-20	Delivery of CAI to small, remote institutions, particularly those 70-80 miles or more away from a major metropolitan area	15-30	15-30	5-10
Computing resources	Multiaccess interactive computing[b]	4-10	5-12	15-30	8-20	15-50	50-80	Delivery of interactive computing to remote institutions for the purposes of problem solving, EIS, etc	15-30	15-30	10-20
	Batch processing (including remote-batch)[b]	7-35	30-50	65-75	15-70	50-80	80-100	Delivery of raw computing power to small, and remote institutions for instruction, administrative data processing, etc.	20-30	20-30	2-5
	Computer inter-connection	0	0	0.8-2	0	5-10	10-20	Interconnection of campus computing facilities for research resource sharing; of centralized regional computing networks for load and specialized program sharing	40-80% of regional computing networks 60-80% of campus computing facilities (higher education)		
Information resource sharing	Interlibrary com.--TWX, facsimile[b]	0	0+	10-20	0.5-1	2-5	20-40	For bibliographic search, inter-library loans, etc.	5-10	25-40	40-70
	Automated remote inform. retrieval[b]	0	0+	0.8-2	0	0+-.5	2-5	For remote information retrieval, automated bibliographic search from specialized centers	0	1-10	40-70
	Teleconferencing (long distance)[b]	0+	0+	4-6	0.5-2	0.5-2	6-10	For access to specialists in distant areas	3-10	3-10	10-30

[a] Percentage expressed in terms of time spent by student in classroom.

[b] Percentage of total educational institutions having this capability.

*From Morgan, Singh et al., (5), developed in 1971.

four main categories: Instructional Television, Computer-Aided Instruction, Computing Resources (excluding CAI), and Information Resource Sharing. Separate estimates are included for each of three educational levels: elementary, secondary, and higher education. Omitted from Table 24, but of potential importance are estimates for services to be delivered to homes and other learning centers.

The estimates of Table 24 represent a very rough cut and should be used with great caution for reasons discussed previously. The utilization which might be achieved in the year 1975 or 1985 will be influenced by a wide variety of factors. These include available budgets for media and technology, political support for media-technology at various implementation levels, the nature and availability of the educational delivery system, the relationship between technology and the teacher and/or the student, the availability of quality and quantity programming, and the impact of copyright legislation - in short, a sizable number of factors, many of which cannot be quantified. These factors should be subject to analysis and estimates revised periodically. They do provide, however, some quantitative basis for examining whether an educational satellite system makes sense. They provide at least an order of magnitude estimate of requirements for an educational satellite system. At best, if the estimates prove reasonably accurate, they can be used to help define alternatives for educational satellite systems with some degree of realism.

In qualitative terms, the right hand side of Table 24 suggests that satellites may have an important role in 1) interconnecting educational institutions, particularly those related to higher education, among themselves and with certain service and resource centers, for sharing of instructional, research and administrative resources, and for providing institutions poor in certain resources with access to services which otherwise might not be available; 2) interconnecting remote and isolated institutions with certain service and resource centers to provide students and teachers therein equitable access to services such as computing, computer-managed/based instruction (CAI/CMI), etc., that are currently more readily available to their counterparts in urban and suburban areas, and to provide in-service teacher development programs; and 3) delivery of both public as well as instructional television and radio programs to cable and ITFS headends and broadcast stations for either real-time or delayed redistribution for in-school as well as in-home utilization.

C. DELPHI FORECAST OF TECHNOLOGY IN EDUCATION*

1. Introduction and Methodology

A Delphi forecast of future use of large-scale technology in education was undertaken by Robinson.(18) Large-scale educational technology was defined as television instruction, computer instruction, and information services. Estimates were made of utilization levels, organizational structures, and values and opinions related to large-scale technology in primary, secondary and higher education as well as early childhood, vocational and technical, adult and continuing, and special education. Impacts upon teachers, students, political systems, economic systems, and social systems were identified and limitations of the forecast were also presented.

From the field of possible forecasting techniques, the Delphi method was chosen because it seemed most suitable for an area as complex and uncertain as education. Trend prediction methods require data which are quantifiable and continuous, but not enough of this type of educational data are available.(293, 294) Trend prediction methods also assume that political, social, and economic forces will continue to interact in the same way as they have in the past, but this cannot be held true for the uncertainties in education. Modeling methods make limited use of values and social forces which cannot be quantified, but these are major forces influencing education.(295, 296) Modeling methods also need causal links between the inputs and the outputs, but education has no such visible links. Intuitive methods such as Delphi are useful in forecasting educational technology because they can utilize unquantifiable and noncontinuous data;(297) they can incorporate new patterns of interaction of political, social, and economic forces; they can include qualitative social and value issues; and they do not require causal links between inputs and outputs.

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*This section is essentially identical to a paper prepared by Robinson and Morgan for the 4th National Educational Technology Conference. (292)

Delphi is a method which attempts to collect opinions about a particular subject from various experts;(298) specifically, the respondents are asked through a series of questionnaires to establish some form of consensus as to the likelihood of selected future events. Two of the distinguishing features of a Delphi study are the feedback of results and the anonymity of the responses: feedback provides the respondents with the results of everyone's estimates and the reasons for them, and anonymity minimizes the negative aspects of interpersonal, group communications (e.g., dominating personalities, bandwagon effects, and digressions from the main topic).

For the purposes of this study, educational technology was divided into three types: television instruction, computer instruction, and information services. Television instruction was defined as educational programming viewed on television sets by either individuals or groups (e.g., commercial or noncommercial broadcast television, closed-circuit television, community cable television, videotape recording or videocassettes). Computer instruction was defined as educational programming guided by a computer and displayed on visual terminals, generally involving two-way interactions as well as variations in the content and pacing for each student (e.g., computer-assisted instruction, computer-based instruction, or computer-managed instruction). Information services were defined as electronic access to resources of interconnected, library or computer facility networks (e.g., large-scale microfilming or audio-visual centers, computerized library systems, data banks of information, time-shared computer facilities, management information systems, or automated data processing services).

In addition, education was divided into six categories: early childhood education, primary and secondary education, higher education, vocational and technical education, adult and continuing education, and special education. These categories do not necessarily correspond with other definitions normally used; for example, vocational and technical education in this study includes only post-secondary training, and special education includes opportunities for handicapped persons as well as opportunities for the elderly, hospital patients, prison inmates, minority persons, and others. In each of the six categories of education the utilization of technology was forecast for public institutions, private institutions, and homes or other informal environments. Utilization was defined as the percentage of locations in which technology is available for use.

Two types of organizational structures were defined: those for the distribution and delivery of the educational technology, and those for the production and storage of instructional materials or services to be used by the educational technology. Values were defined in relation to political, social, or economic impacts, assuming that the use of technology will cause changes in the values held by people just as the values held by people will cause changes in the use of technology.

2. Results

The results of the Delphi forecast are presented here for what will happen by 1990 in terms of the utilization levels of educational technology, the organizational structures related to educational technology, and the impacts of educational technology upon teachers, students, political systems, economic systems, and social systems. Although the results are presented as definite statements, they still represent only a consensus opinion of one group of experts giving their best estimates of probable events.

a) Utilization of Technology

Large-scale educational technology will be generally in moderate usage; that is, it will be found in around half of the various educational institutions. (See Figure 45.) While over-the-air broadcasting will still be popular, many cities will be wired into large networks providing an assortment of communication services, many of them educational. Communication satellites and terrestrial microwave facilities will provide these services to rural areas. Videocassettes will become commonplace. Educational technology will be a package service; that is, the hardware components together with the instructional materials and services will be available to educational institutions.

As much as educational technology is separable into distinct services, television instruction will be the most widespread. Television instruction will occur in 60-79 percent of the public institutions and homes, with slightly less use in private institutions. Information services will be next, being utilized in 40-59 percent of the public and private institutions, with lower usage in the homes and in early childhood education. Generally speaking, computer instruction will be found in 20-39 percent of the public, private, and home or other locations of education. The cost of terminals will be low enough for many educational services to be provided in the home. Those services which still remain too expensive will be available in neighborhood or community centers.

The growth of technology will be such that initial levels of utilization will be followed by rapid rises to widespread usage, with upper limits to the growth of technology. The growth will also fluctuate in cycles, responding to interactions of technological, political, social, and economic forces.

	Percent Utilization				
	Initial 1-19%	Develop-mental 20-39%	Moderate 40-59%	Heavy 60-79%	Wide-spread 80-99%
TELEVISION INSTRUCTION					
Public institutions				EC PS VT H S AC	
Private institutions			EC PS H VT	S AC	
Home or other				PS VT H EC AC S	
INFORMATION SERVICES					
Public institutions		EC	PS VT AC H S		
Private institutions		EC	PS H VT S AC		
Home or other		PS EC VT S	H AC		
COMPUTER INSTRUCTION					
Public institutions		EC AC S	VT PS H		
Private institutions		PS EC AC S	H VT		
Home or other		PS EC H AC VT S			

KEY:

EC = early childhood education	PS = primary and secondary education
H = higher education	VT = vocational and technical education
AC = adult and continuing education	S = special education

FIGURE 45: UTILIZATION OF TECHNOLOGY IN EDUCATION - 1990(292)

Technology will work best when it fits the needs of the people involved; for example, television instruction which fits the educational needs of early childhood, computer instruction which teaches basic language or math skills to ghetto or rural children, and information services which fulfill needs of the handicapped or the blind.

b) Organizational Structures

Delivery systems for educational technology will be coordinated and operated at local, state, regional, and national levels, with more emphasis on the local organization than on national structures. (See Figure 46.) Two-thirds of the financing and control of the delivery systems will be public, with the remainder private. The most popular form of distribution will be cable television, followed by over-the-air broadcasting, communication satellites, and terrestrial microwave stations.

The instructional materials and services will be produced and stored by organizations which are national rather than local, in order to achieve economies of scale. The control and financing of these systems will be split evenly between public and private sources. Access to the materials will be scheduled in part by the users and in part by the distributors; likewise, the costs will be split evenly between the users and some form of subsidization.

c) Values and Opinions

(i) Impact on Teachers (See Figure 47.)

Although it may be difficult to determine whether technology instructs better than teachers, technology will be responsible for major changes in the types and methods of instruction. Teachers, however, will not be replaced by technology. They will remain necessary to fulfill the essential

	Percent of System				
	1-19%	20-39%	40-59%	60-79%	80-99%
Organization					
local	●	■			
state		● ■			
regional		● ■			
national		■	●		
Control					
public			●	■	
private		■	●		
Financial sources					
public			●	■	
private		■	●		
Access - scheduling					
user			●		
distributor			●		
Cost of programming					
user			●		
subsidization			●		
Distribution methods					
cable television		■			
over-the-air		■			
terrestrial microwave	■				
communications satellites	■				
other	■				

KEY:
■ Delivery systems ● Educational materials and services

FIGURE 46: ORGANIZATIONAL STRUCTURES FOR EDUCATIONAL TECHNOLOGY SYSTEMS - 1990(292)

STRONG ACCEPTANCE

- Education should be thought of as something which extends throughout a lifetime, with individuals leaving and returning at various times in their lives.
- The development of educational data banks of grades, test scores and personal information on students should contain adequate safeguards to protect the privacy of individuals.
- If the combination of educational technology and teacher can do a better job at the same cost, the combination should be used.

MODERATE ACCEPTANCE

- Para-professionals, student teachers, multi-media technologists, and teacher's aids should be accepted as important and necessary components of the educational process.
- The individual student should have access to the information about him which is stored in educational data banks.
- If the initial costs of implementing educational technology are high, federal or regionally shared money should be used to pay initial costs for poorer schools.
- Educational institutions should be held accountable for the educational methods they use and results they obtain in terms of quantifiably measurable outputs (e.g., using PPBS, PERT, and other productivity measures).
- If the combination of educational technology and teacher can do a better job at somewhat higher costs, the combination should be used.
- Copyright laws should protect an author's rights for instruction materials which become part of a computerized software system.

FIGURE 47: VALUES AND OPINIONS OF PEOPLE - 1990(292)

MODERATE ACCEPTANCE (Cont.)

- Copyright laws should enable the freest possible access to instructional materials by students and teachers.
- Educational programming should incorporate elements of entertainment into its material.
- Education should be available to all who want it 24 hours per day, 365 days per year.

SLIGHT ACCEPTANCE

- Curricula should contain significant amounts of non-academic (experiential) items and should remain highly flexible in content.
- Assuming that educational technology cannot effectively transmit certain socialization and cultural values, methods and institutions similar to those in 1973 should be maintained to accomplish these purposes.
- With the aid of technology, educational institutions should be better able to define their goals and functions.
- If educational technology can do the same job for considerably less cost, it should be used to replace the teacher.
- Technology should be used to study ways to improve theories of behavioral conditioning so that students will learn the correct responses with greater ease and speed.
- Schools should continue the "custodial functions" (i.e., babysitting children during the day and keeping them out of the labor force).

NO OPINION

- National or regional degree-granting organizations should be created to relieve the job of certification and degree-granting from educational institutions.

FIGURE 47: VALUES AND OPINIONS OF PEOPLE - 1990 (Continued)

NO OPINION (Cont.)

- Assuming it is true that technology creates feelings of alienation, deindividualization or dehumanization, then it should be kept out of education, no matter what the learning benefits are.
- Standardized programming should be avoided because it produces a bland and sterile, mass education.

SLIGHT REJECTION

- In an attempt to equalize educational opportunities, educational technology should be used in richer schools to generate savings which could be used to improve poorer schools.
- If educational technology can do the same job for the same cost, it should be used to replace the teacher.

MODERATE REJECTION

- Educational technology should be looked upon by teachers as a threat to their job security or an infringement upon their classroom control.
- Standardized programming should be used in poorer school districts while affluent school districts should take advantage of the variety and diversity of programming which they can afford.
- The federal government should determine the content of educational software.

STRONG REJECTION

- The socio-economic background of a student should determine the kind of educational opportunity provided to a student.

FIGURE 47: VALUES AND OPINIONS OF PEOPLE - 1990 (Concluded)

emotional needs of students: love, affection, motivation, discipline, and counseling. Furthermore, teachers will remain necessary to fulfill essential societal needs of custody and socialization: babysitting children during the day, keeping them occupied while they are out of the labor force, and transmitting cultural values and goals of the society to the children. There will be little support for replacing teachers with technology, even when doing so would lower costs. On the other hand, there will be a great deal of support for using a combination of teachers and technology to do a better job of education, even if it means higher costs. The role of the teacher will be modified to include being a resource person and learning manager, and teachers will have numerous asistants (e.g., paraprofessionals, multimedia experts, teacher's aides, and student teachers).

(ii) Impact on Students

In spite of financial resource differences between school districts, there will be an equalization of the educational opportunities which are provided. Federal or regionally shared money will be used to help poorer school districts purchase educational technology. Standardized programming will not be used in poorer school districts when, at the same time, a variety of diverse programming exists in richer school districts. Furthermore, the use of technology in richer school districts to save money for improvements in poorer school districts will be unpopular. There will be a strong feeling that the socioeconomic background of the student should not prevent him from receiving the same educational opportunities as others. Once inputs become equalized, however, the issue of equal outputs of the educational process will become important.

The concern for the individual will lead to attempts to tailor the instructional materials to the needs and desires of each student. Controversies over standardized programming and required courses will occur. Consumer rights and protection movements will argue that each individual should have control over the content and scheduling of his own educational experience. There will be the further problem of who determines the appropriate content and scheduling of educational experiences for children - teachers? parents? administrators? the children themselves?

(iii) Political Impact

The privacy of personal information stored in educational data banks will be safeguarded; moreover, students will have the right to know what is contained in their files. Copyright will present a dilemma; at the same time that the author's rights are protected and due rewards are insured, there will also be a concern for the freest possible access to instructional materials by students and teachers. Perhaps the biggest political issue will be local versus national control of education. National control will be necessary in planning and organizing educational technology to insure equal opportunities, individualized instruction, and standardization of the components of educational technology systems. Federal control of the content of educational materials, however, will be rejected by most people. State or local control of the content and scheduling of instruction will be maintained. Regional consortia for the organization and storage of material will be one alternative. Still there will be conflicts between local and national agencies over the regulations, policies, goals, and functions of educational technology, resulting in confusion, indecision, and delays in the development and use of the technology - as is happening with cable television today.

(iv) Economic Impact

Costs of educational technology will continue to be a major concern, necessitating heavy funding along with concomitant control by public agencies. Economies of scale will be realized through large-scale, national or regional facilities for the production and storage of educational materials and services. The market will be attractive to private enterprise, university centers, and research institutes. Private corporations will team up with private educational institutions to provide educational opportunities in early childhood, vocational and technical, adult and continuing, and special education. Successes in these areas will spur greater use of technology in primary, secondary, and higher education. The growth of educational technology will lead to growth in new, related industries: electronic publishing, national computer utilities, digital data common carriers, high speed information transfer, miniaturization of communication media, computerized planning systems, and domestic satellite corporations.

Quantitative means of measuring effectiveness and productivity in education will be popular. Manpower planning, cost-effectiveness techniques, accountability measures, PERT (Program Evaluation and Review Techniques), and PPBS (Programming, Planning, and Budgeting Systems) will be used in education, health, and welfare services as investments in capital replace some investments in labor. These services, however, will remain labor intensive activities. Certain aspects of education never have and never will lend themselves to being measured in quantified ways, because some of the variables involve aesthetic and subjective judgments. Furthermore, the many variables in constant, complex interaction make it virtually impossible to establish the causal relationships in education which link inputs to outputs.

(v) Social Impact

Society, like any large, biological system, is complex and stable; moreover, it changes slowly. Technology, an aggressive and fast-moving beast, is of a nature which encourages rapid change. In concert, these two forces can work to introduce gradual changes in social institutions and social values. Combined with other forces such as politics and economics, significant new relationships in society can occur.

There will exist a general apprehension of technology because of earlier failures and misapplications, some from poor planning or execution, some from faulty technology, and some from improper assessment of the needs and desires of the people involved. Technology will serve to weaken education if it is used as a mechanical device which replaces teachers. On the other hand, technology will have the potential, when used as a process instead of a device, to strengthen education; it can be used as one vehicle for the rehumanization of a technological society. Educational technology has the potential for being much more than merely a mechanism to transfer information; it can be a medium of communication, motivation, stimulation, and entertainment.

Partly as a result of technological changes, the goals and functions of education will be modified. Curricula will contain significant amounts of non-academic, experiential items and will be quite flexible. There will be some interest in establishing national, degree-granting institutions, but no concerted effort. Education will be thought of as extending throughout a lifetime, with people leaving and returning at various stages of their lives. Education will be offered more times of the day and more days of the year, including special holiday and vacation education-travel programs.

Increased leisure time and increased longevity will contribute to greater demands for adult and continuing education programs. Educational institutions will become more flexible, the newer ones making greater use of innovations and technology. On one hand, schools will remain custodians and socializers for society; on the other hand, many locations will become multi-purpose as recreation, education, and career become blended and interdependent.

3. Limitations

There are limitations to the completeness and accuracy of this study. Some of these limitations could have been avoided; others are inherent in any method of forecasting educational technology.

Avoidable limitations involve the definitions and the experts which were used. The distinctions in the definitions of educational technology may prove unrealistic. The technology might develop in some hybrid manner such that television instruction and computer instruction are combined with various information services, thus making it difficult to determine which will come first. Also, the definition of utilization levels includes only the percentage of locations in which the technology will be available for use, with no indication of when it will be used or how many hours it will be used for educational purposes. No definition is attempted to explain which uses would be considered educational and which would not. Furthermore, the definitions of the categories of education make no distinctions as to the age of the students, and this may be an important variable.

The experts who participated in this study were all volunteers, a fact for which we are very grateful. Nevertheless, some limitations result from using volunteers. There was no way to insure that a complete range of opinions was obtained. Thirty of the respondents to both rounds of the questionnaire were technologists, planners, professors, and administrators; only nine were teachers, students, or other groups of people likely to be affected by educational technology. It is likely that only the more optimistic people have responded; those who fear or distrust technology may not have bothered to spend the time necessary to complete the questionnaire. In addition, those panelists with specific expertise in a particular area of the forecast were less optimistic than the majority opinion for that particular area.

Some of the limitations of this study are inevitable in forecasting educational technology. Social phenomena are not predictable in the same sense as controlled scientific experiments; therefore, there are no "right" answers. All forecasters and Delphi respondents have values and opinions, including prejudices and biases, which may cause them to view the future as they would like it to be, and not as it probably will be. Accuracy is impossible to measure in any forecast because only guesses can be made of what the future would have been if no forecast were done - self-fulfilling prophecies result from merely doing a forecast. Completeness is also a problem of any forecasting method because, as a result of specialization, experts are less able to see the more generalized interactions of technological and social changes.

Finally, it is very difficult to incorporate the essential element of creativity into forecasting methods. Forecasting should be, in part, a creative art; irrationality, luck, uncertainty, and accidental discoveries - all part of change in the "real" world - should be included somehow in any forecasting methodology. If not, the rational and cautious methods which accept the conservative assumption at each step of the forecast will prevail, resulting at times in extreme understatements of the future.(293) Boldness and imagination are necessary to foresee technolgical breakthroughs and revolutionary changes which may occur. As flexible as intuitive methods of forecasting are, they still do not insure creative views of the future.

4. Implications

These results have implications for the development and use of educational satellites. A fairly extensive utilization of technology in a variety of educational sectors by the year 1990 would indicate that markets for large-scale educational telecommunications systems may develop. The extent to which communication satellites are a part of those systems will depend to some extent upon the relative economic advantages of satellites versus alternative transmission schemes.

Satellites may have an advantage in the delivery of educational material and services to rural areas and in instances where large numbers of users can be aggregated. One difficult problem, however, which faces all prospective large-scale educational technology delivery systems, is designing for such systems the appropriate organizational and administrative frameworks which are consonant with the highly complex, decentralized nature of U.S. education. Laying out alternative frameworks and market scenarios which include estimates of satellite channel capacity requirements and the number and location of various types of earth terminals has been undertaken at the Center for Development Technology(1) with some results of this Delphi forecast proving useful in that work.

Perhaps the most important implication of this study is that it is necessary to consider the impact of satellite technology on education and on society. Social impact analysis is not trivial. Few reports have studied the impact of the automobile, television, or computers, and these technologies have had considerable impact on social and value changes. Not only will technological change impact social and value changes, but social and value changes will impact the growth and development of technology. The time has come for the recognition of this interaction in planning educational satellite systems.

V. SUMMARY ANALYSIS AND CONCLUSIONS

A. INTRODUCTION

In this report, an effort has been made to assemble and analyze a large amount of diverse information which would seem to be relevant to future educational satellite utilization in the U.S. The status, trends and issues in a variety of educational subsectors were examined along with current technology utilization in each subsector. Educational telecommunications services were defined and attempts to forecast future technology utilization in education were described.

Much of the content of this report stems from a variety of research reports developed by our research group since September, 1969. Such a long study period enables one to gain perspective and an overall "feel" for an area in a way which is not possible over a more limited period. On the other hand, situations can change with time, statistics become out of date, forecasts can be proven incorrect, and once pressing issues become less pressing as new issues emerge. Furthermore, the field of education is so huge and diverse, affects the lives of so many people, and is so socially oriented and value laden that the precise mission requirements that the satellite system designer normally expects in other areas, e.g., defense, are extremely difficult to define.

The "Needs Analysis" presented in this report to some extent parallels approaches taken by others. In 1974, an article by Curtis appeared in Engineering Education entitled "Needed: A National Telecommunications Network for Education."(20) In that article, Curtis summarizes the potential "student body" which might be served by such a network. (See Table 25.) He also includes estimates of network costs and recommends that a National

TABLE 25.—America's Potential "Student Body" (From Curtis, Ref. (20))

	Total by Category	Those Now Being Served	Those Not Being Served	% Not Served
1) Pre-school young (no curriculum, no communications links)	11,424,000	3,949,000	7,475,000	65.4%
2) Physically handicapped & homebound (no communications links, no accomodation of the curriculum)	389,500	191,946	197,554	50.7%
3) Lower economic classes (unable to afford direct or indirect costs)	16,000,000	7,000,000	9,000,000	56.3%
4) Communicatively disordered – deaf, blind, dyslexic (system presupposes entering behaviors which these people lack)	2,934,500	1,493,672	1,440,828	49.1%
5) "Educationally averted" dropouts (past reinforcement from the system leads them to predict more 'failure experience')		(Elem. 4%	1,473,800)	
		(High 24%	3,552,000)	
	7,636,800	(Coll. 50%	2,611,000)	
			7,636,800	
6) Aptitudinally unique (same as #4)	3,783,000	1,195,000	2,588,000	68.4%
7) Basic skills – deficient (same as #4)	665,000	221,000	444,000	66.8%
8) Incarcerated – institutionalized (same as #2, neglected & juvenile del.)	175,000	175,000	NDA*	
9) Socially-culturally different (system presupposes values which they do not have)		215,000 Migrant		
	340,000	125,000 Indian	NDA*	
10) Geographically remote (same as #2)	1,500,000			
11) Temporarily out of phase (night)	1,500,000	1,500,000	NDA*	
12) Older & retired (same as #2, poss. #3)	275,000	25,000	250,000	90.9%
13) Spec. educ. training skills (mgmt. etc.)	13,000,000	13,000,000	– –	
TOTAL	58,123,600		21,395,382**	
14) Formal Education		1970	1975	
K-12		51,600,000	51,000,000	
Undergraduate		6,662,000	8,368,000	
Graduate		946,000	1,334,000	
Noncredit		666,000	962,000	
Part-time credit		1,576,000	2,043,000	
	TOTALS	61,450,000	63,707,000	

*NDA – No data available. Figures rounded to nearest 1,000. Revised 4/5/73

Source of Data: U.S. Office of Education and the Department of Commerce.)

**If drop-outs are included, this figure would be 29,032,182

Telecommunications Authority be established to plan for such a network. Although we have presented some of Curtis' results in Table 25, we have hesitated to summarize our own findings in this manner because the issues and questions involved seem much too complex. Instead, we have tried to develop a detailed understanding of the situation in each educational subsector and to assess relevant experience to date with communications technology.

A somewhat different approach has been taken on a more modest scale by Horley and Hupe of the Office of Telecommunications Policy, DHEW.(83-85) Again, numbers of students in several categories are singled out although on a more selective basis in order to identify most promising "markets" for educational telecommunications services. Part of the emphasis in these studies seems to have been on building a case for educational use of one 2.5 GHz channel on a domestic commercial satellite.

A more recent article by Hupe entitled "Markets For a Social Services Satellite" indicates OTP-HEW interest in aggregating markets and working towards a user consortium.(305) In early 1975, a Public Service Satellite Consortium was formed, consisting of potential users of satellites in the education and health sectors.(307) It is to be expected that a fresh and detailed examination of needs and requirements will be undertaken by that organization.

A "Needs Analysis" of another sort was being carried out in 1974 by the Advisory Council of National Organizations of the Corporation for Public Broadcasting. Four Task Forces of the Council are developing recommendations to CPB concerning the Corporation's future role in the fields of Early Childhood Education, Elementary and Secondary Education, Post-Secondary Education and Adult Education. An effort is being made to obtain the views of a broad cross-section of individuals from throughout the U.S. This development is of particular importance because CPB/PBS/NPR represents probably the only major currently existing framework for educational broadcasting which is national in scope, although its emphasis up until now has been on "public" broadcasting.

The information and analyses in this current needs analysis report can serve as the basis for a variety of individual efforts to develop market scenarios for educational telecommunications systems. One attempt to do so by Walkmeyer of our research group has been carried out and is presented in an accompanying report.(1) It is likely that no two people will agree on which are the most likely prospects for increased large-scale technology utilization just as they may not agree on what is really needed in education. One difficulty with summarizing tables of "potential" audiences is that one may lose sight of the fact that educational telecommunications is still not a significant factor in the overall field of education. There are clearly other educational strategies which can be pursued to help meet perceived needs which may involve little if any technological inputs.*
Therefore, we encourage the reader, the planner, the policy maker and the public to draw their own conclusions from the information and analyses we have presented, or to use this report as a starting point for more detailed analyses of particular aspects.

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*The problems associated with "technological fixes" have been well illustrated by Nelkin. (301)

B. PROSPECTS FOR LARGE-SCALE EDUCATIONAL TELECOMMUNICATIONS UTILIZATION

In what follows, somewhat broad, general conclusions will be summarized concerning prospects for future utilization for large-scale educational telecommunications in various educational subsectors. These conclusions are based upon the analyses of Chapter II which also contains more extensive statements of these conclusions.

1. Elementary and Secondary Education

In spite of the large numbers of elementary and secondary school children in the U.S., forces acting against technology utilization are great. Trends to watch which may foster increased technology utilization include the extent to which "productivity in education" gains credence, the extent to which in-school use of television increases through efforts such as the Electric Company and the Agency for Instructional Television, the extent to which CAI programs initiated through various "Great Society" programs in large cities make further inroads, and the extent to which electronic educational information systems catch on. Although direct, large-scale technology use in this sector is not likely immediately, some involvement is expected through specific kinds of programs (career education) and because even a relatively small percentage of students in this category constitutes a large audience.

2. Post-Secondary Education

Post-secondary education is probably one of the more promising areas for large-scale telecommunications technology development. Supporting trends to watch include the PLATO and TICCIT CAI projects at the community college level and possible regionalization of television-based instruction as exemplified by the new University of Mid-America. Considerable interest and activity also exist in computer resource sharing and information sharing among institutions. Self-interests of a not-negligible number of university personnel appear tied to future development. However, resistances are present and satellite utilization will have to contend with other technologies now in use. Medical education appears particularly ripe for technology utilization.

3. Vocational/Technical Education

Although there has been a marked increase in federal funding for vocational/technical education in recent years, this sector remains fragmented in terms of number of organizations involved, federal vs. state and public vs. private jurisdiction, and subject matter contained. Smaller-scale technologies such as video discs and cassettes may be more likely to make inroads for instruction than satellite utilization. Much more promising is the career education area which is less occupationally specific and which figures prominently in educational satellite experiments.

4. Adult Education

This sector appears promising for large-scale electronic delivery. Audiences are potentially large. Although CPB did not follow through with Project ALPS for national distribution as originally planned, additional efforts may be forthcoming. GED programs like Kentucky Educational Television offers and Adult Basic Education seem to have reasonably high social priority. Satellite utilization in this sector may hinge upon whether or not Public Broadcasting goes satellite.

5. Continuing Professional Education

Continuing professional education has some history of technology utilization, particularly in engineering and engineering related fields. The technologies employed such as ITFS systems and videotapes tend to serve cities, states or regions. Ofttimes, programs are viewed at industrial locations and industry contributes to the support of the various systems. There seems to be less well established technology utilization in law and teaching.

Satellite utilization may be inhibited by relatively limited audiences and the fact that some local and intrastate systems appear to be functioning well. On the other hand, the fact that electronic technologies are being used would indicate that further development may be possible.

6. Early Childhood Education

Sesame Street, a program geared towards teaching basic letter, number and other skills to preschoolers, represents an important example of large-scale television dissemination in the early childhood sector. Public broadcasting serves as the nationwide delivery system for the program and the Children's Television Workshop as the production organization. Further development in this sector could conceivably be held back by the success of Sesame Street as other sectors are singled out for attention, although "nothing succeeds like success." Public broadcasting is likely to play an important role in dissemination of early childhood education and some commercial television involvement might be anticipated as well. Thus, the extent of satellite utilization will depend on whether public and/or commercial broadcasting find this technology to be cost-effective compared with other distribution alternatives.

7. Education for the Handicapped Child

Although education for the handicapped must of necessity remain labor intensive, the high social priority afforded this field will probably result in increasing technology utilization. The form the technology and the technology-student interface will take will depend upon the nature of the handicapping condition. Although much of the utilization may be local or small scale, it is possible that some nationwide supportive services may develop which would require satellite utilization.

8. Education for Culturally Diverse Groups and Geographically Distinct Regions

This educational subsector plays a very important role in technological innovation in education. Many large-scale technologies have been developed with some specific group singled out for early utilization. For example, Sesame Street was geared initially to inner-city preschoolers. Early school-age CAI programs were funded by Title I and Title III programs and serve Black children in large cities. The ATS-6 satellite experiment was to some extent aimed at broad ethnic and minority representation in the region.

For satellite utilization in particular, geographic regions form the focal point for activity. Widespread, remote regions for which other technologies may prove more expensive such as Alaska, Appalachia, the Rocky Mountain States and the Pacific area have been the scene of past and current activity. Other regions will be involved in the CTS experiments.

It seems essential that there be increased participation of minority groups and individuals in educational telecommunications activity. Growing attention is being paid to cable and public television by Black groups and other minorities. Satellite utilization could conceivably help promote new minority controlled networks which are national in scope.

9. Education for the Aged and Institutionalized

Improved programming delivered to institutions, e.g., prisons, nursing homes, etc., may find ready acceptance in part because of the restricted options of the persons involved. Some community colleges are actively involved in accredited educational television activity in prisons. Whether a need for a nationwide construct will arise remains to be seen.

Older Americans represent a relatively large group with educational needs which do not appear to be met by current communications. New programming initiatives, developed within a national framework may very well receive a good reception.

C. EDUCATIONAL TELECOMMUNICATIONS SERVICES: PREDICTING FUTURE UTILIZATION

In Chapter III, several educational telecommunications services were described, with some emphasis on distribution mechanisms for these services and the role of satellites in service delivery. Among the services discussed were public broadcasting, instructional television, computer-assisted instruction, computer resource sharing and information resource sharing. Figure 6 summarizes potential uses of satellites for delivering these services.

In Chapter IV efforts to predict future utilization of large-scale telecommunications technology in education are summarized. Two such efforts were carried out in connection with this research project. One, an early (1971) effort, attempts to be very quantitative and to specify not only overall technology utilization but also to give some indication of what proportion of this utilization might involve satellites. Results are summarized in Table 24. Another later (1973) effort used the Delphi method to forecast technology use in education without singling out satellite delivery. Some results are summarized in Figures 45 and 46. These forecasts are meant to be rough guides for the educational telecommunications systems designer and should only be used with great caution. Their limitations, which are severe, have been discussed in Chapter IV.

D. POLICY IMPLICATIONS AND IMPLEMENTATION CONSIDERATIONS: SOME INITIAL REMARKS

The picture of the educational telecommunications field which emerges in the U.S. has certain implications for future policy. An attempt will be made to briefly discuss some of these considerations. A more detailed policy analysis is being carried out in the educational satellite field by Syracuse University Research Corporation under NIE sponsorship.

1. Structure of Education

Education in the U.S. has traditionally been a local concern, with an overlay of state regulation. The federal role has increased in recent years with federal funding and programs often serving as the prime mover in innovation and the setting of new directions.

Technological innovation has tended to flourish where new mechanisms have been established to circumvent old obstacles.* Examples are Sesame Street and Electric Company, created by Children's Television Workshop and delivered by Public Broadcasting; Title I and Title III programs which helped get CAI introduced into urban school systems; and university and non-profit researchers who are creating new systems, e.g., PLATO and TICCIT, which will be tried out in the newest of established higher educational institutions, the community colleges.

The extent to which technological innovation will make long-term inroads in education will depend upon a number of factors, including the existence of organizations which foster their use, the extent to which educators and administrators feel such innovations are cost-effective, and the financial condition of education. For satellite utilization, some sort of national construct is required. Early experiments have involved regional organizations such as the Appalachian Regional Commission and the Federation of Rocky Mountain States. At present, the Corporation for Public Broadcasting is expressing renewed interest in education, a very important development which should be watched closely.

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*Two of the authors, Rothenberg and Morgan are carrying out a study of policies for innovation in the educational service sector under NIE and OECD auspices.

2. Structure of Educational Telecommunications

Activities in the U.S. which relate to educational telecommunications are fragmented. There is no one agency in the government which focuses on communications. Much of the thrust for satellite technology utilization to date in non-defense sectors has emanated from NASA. However, NASA made a decision to withdraw to a significant extent from the communications satellite field as of January, 1973, leaving future development up to industry. Concern for educational satellite utilization now seems to be centered in the National Institute of Education, which is responsible for the ATS-6 experiment, the Office of Telecommunications Policy of HEW, the CPB/PBS public broadcasting agencies, and to some extent with NASA which still has obligations with regard to ATS-6 and CTS.*

The general support base for educational satellite utilization is very limited in terms of numbers of people and dollars. Private industry must of necessity focus upon revenue and profit generating activities. Public sector satellite utilization clearly requires some pump priming, market demonstrations and aggregation. Given the current state of affairs, the support base for educational satellite activity is relatively weak.

3. Continuity

Currently, educational satellite experiments are underway. The ATS-6 demonstration, using 2.5 GHz receivers and a relatively high-power satellite, encompasses a variety of education and health activities in Alaska, Appalachia and the Rocky Mountain States. A follow on high-power satellite experiment, (CTS), involving 12 GHz receivers, is scheduled for late 1975 and will involve additional educational satellite activity. By early 1975, low power commercial domestic satellites were also in orbit. The limitations of the original (1971-1972) domestic commercial satellite system proposals for educational users have been pointed out elsewhere.(5)

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*The Office of Telecommunications Policy of the White House is also concerned broadly with public service uses of communications.

As things currently stand ATS-6 is scheduled to be used in the U.S. for about one year, beginning in June, 1974, and then deployed for use in India. Follow on activity by NASA, in the form of the ATS-G program and the planned ATS-H and I satellites, has been abandoned. Hardware options, therefore, for orderly development of educational satellite activity appear limited to use of ATS-F (perhaps bringing it back to the U.S. after the India SITE experiment), CTS, an ATS-F' follow-on and the commercial DOMSATS. (See Section IIC4e.)

By early 1975, there were two significant new initiatives which gave hope that operational educational satellite activity might one day become a reality. PBS/CPB in collaboration with the Ford Foundation were in the process of planning for satellite interconnection of 150 public broadcasting stations. Although not completely firmed up, it was hoped that four full-time transponders could be obtained from a commercial satellite operator for a 1977 start date. These satellite are relatively low power and would require fairly expensive ground terminals.

At the same time, a Public Service Satellite Consortium was formed, consisting of potential users from the education and health sectors. This organization will explore a number of possible satellite options. It will be concerned initially with developing a sufficiently strong user base, articulating its requirements and seeking financial support.

Of these two developments, the PBS/CPB initiative has the advantage of a well-established organizational structure to build upon with substantial financial support. PSSC on the other hand, may be able to coalesce a broad spectrum of potential users. Cooperation on the part of both these organizations may serve to enhance the prospects for both.

4. Impacts of Large-Scale Educational Telecommunications Systems

In an accompanying document, specific markets for educational satellite systems are developed and alternative organizational and administrative frameworks outlined.(1) A major issue which arises is the extent to which governmental control of a large-scale educational telecommunications system can be avoided. The local control of U.S. education, coupled with traditional suspicion of government involvement in or control of media, present formidable issues for the systems designer to consider. It is likely that any system to gain acceptance must conform to these sentiments.

A large-scale educational telecommunications system may have a number of profound impacts, some of which may not be foreseen beforehand. One of these, the privacy issue, has been discussed briefly in Section IID3. This issue is currently of great concern, particularly in connection with interactive or two-way educational telecommunications services which may develop. Other, more long-term impacts to consider include the possible humanizing or dehumanizing effects of increased educational technology utilization, the impact on employment in education, the extent to which access to educational telecommunications systems is "open," and the extent to which such systems foster rather than impede greater social justice in the U.S.

There is a need for major impact analyses to be performed of any large-scale educational telecommunications systems which are proposed, prior to decisions to implement such systems. An effort to begin to identify and assess such impacts has been initiated.(311) Such an analysis should involve those people most likely to be affected by such a system, namely, teachers and students.

5. Educational Satellite System Alternatives

In earlier work,(5) we indicated that there are at least three distinct ways in which satellite systems for education might be developed. One alternative would be to obtain necessary channel capacity at full-cost, reduced-cost, or no-cost terms from the commercial satellite systems that are coming into existence. An educational network could be built using commercial earth terminals, where convenient, as well as those specified to serve the needs of the educational community. The second approach would be to construct a dedicated educational satellite system by deploying a relatively high-power satellite capable of serving a large number of nodes directly. Such a system could connect earth terminals with operating centers and/or redistribution points without making use of any terrestrial microwave-relay "tails." Yet a third alternative would be to base the educational satellite system on a combination of commercial as well as dedicated satellites. Commercial satellites would be used to interconnect and feed redistribution points of common interest, such as CATV headends, while dedicated educational satellites would serve redistribution points and areas not likely to be served by commercial operators.

The analysis presented in this report can be used to develop scenarios for implementing any of these system alternatives. In a parallel study, we have made use of this information to develop a set of channel requirements which might be used to define a large-scale dedicated or hybrid system.(1) Although prospects for such a system did not look particularly bright at the end of 1974,* we believe that the exercise of defining channel requirements does indicate that a plausible case can be made for more extensive educational telecommunications utilization, subject to some of the limitations we have pointed out previously. We have also presented four widely varying alternative organizational frameworks for educational satellite utilization: (1) a system that builds upon and extends public broadcasting activity, (2) an educational user controlled, public system, (3) a commercial system which leases channels to educational users, and (4) a system developed with public funds which eventually is transferred to private control.(1)

Elements of at least three of these alternatives can be found in the recent PBS/CPB and Public Satellite Service Consortium planning initiatives. It is hoped that our analyses will prove useful in connection with these efforts.

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*There is a poster in the halls of the National Education Association building in Washington which says something like, "Oil Companies Made 9 Billion Dollars in Profits Last Year While Teachers Real Buying Power Fell in 47 States. Elect a Pro-Education Congress." The cost of a large-scale dedicated educational system might come to a fraction of one percent of what is spent annually on education in the U.S. But at a time when all budgets are hard-pressed, new initiatives are difficult to mount.

E. POSTSCRIPT

The work presented in this report has been performed by an interdisciplinary university research team representing individuals with a wide variety of backgrounds ranging from engineering to education to broadcasting to the social sciences. Therefore, we believe our perspective has been reasonably broad. However, we realize that no two groups of individuals will hold the same perceptions concerning topics as varied and as value laden as those contained in this report. We do not claim that our analysis of educational subsectors or needs is representative of the views which might be held by those most affected by a large-scale educational telecommunications system, namely, administrators, teachers and students. Failure to involve these individuals in educational technology activity in the past has been an important element in the demise of such programs. If our report can serve to stimulate those with the most to gain or lose, to examine the potential and problems associated with a large-scale educational telecommunications system and ways in which such a system might interact with their own needs and concerns, then our undertaking will have been worthwhile.

REFERENCES*

1. Morgan, R. P., Singh, J. P., Walkmeyer, J., et al., "Satellites for U.S. Education: Technology, Markets, Economics, Alternative Systems and Implications," (forthcoming).

2. "Progress Report: Washington University Program on Application of Satellite Communication to Educational Development," Submitted to Office of University Affairs, NASA, January 20, 1970 (Out of Print).

3. "Progress Report: Washington University Program on Application of Communications Satellite to Educational Development," Submitted to Office of University Affairs, NASA, November, 1970 (Out of Print).

4. "Progress Report: Washington University Program on Application of Communications Satellites to Education Development," Submitted to Office of University Affairs, NASA, November, 1971. (Available as ERIC document number ED 062 777.)

5. Morgan, R. P., Singh, J. P. et al., "Satellites for U.S. Education: Needs, Opportunities and Systems, AIAA Paper No. 72-523, Fourth AIAA Communications Satellite System Conference, Washington, D.C., April 24-26, 1972. Revised Edition Published in AIAA Progress in Astronautics and Aeronautics Series, Communications Satellites: Systems and Advanced Concepts, MIT Press, pp. 441-480, Cambridge, 1974.

6. Singh, J. P., Morgan, R. P., and F. J. Rosenbaum, "Satellite Networks for Education," Proceedings of International Telemetering Conference, Los Angeles, California, October 10-12, 1972, p. 419-439. Available as ERIC document number ED 070 273.

7. Ohlman, H. M., "Communications Media and Educational Technology: An Overview and Assessment with Reference to Communications Satellites," M. S. Thesis, Department of Applied Mathematics and Computer Science, Washington University, Report No. (R)T-71/1. (232 pp.) May, 1971. Available as ERIC document number ED 053 540.

8. Singh, J. P. and R. P. Morgan, "Computer-Based Instruction: A Background Paper on Its Status, Cost/Effectiveness and Telecommunications Requirements," Memorandum IM-71/1 (36 pp.), April 10, 1971. Available as ERIC document number ED 055 429.

9. Singh, J. P., and R. P. Morgan, "Educational Electronic Information Dissemination and Broadcast Services: History, Current Infrastructure and Public Broadcasting Requirements," Memorandum IM-71/3 (90 pp.), August, 1971. Available as ERIC document number ED 055 419.

10. DuMolin, J., "Instructional Television Utilization in the United States," Memorandum 71-6, (48 pp.), October, 1971. Available as ERIC document number ED 055 427.

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*References 1 through 19B are from Center for Development Technology, Washington University, St. Louis. Additional CDT reports are identified individually.

11. Singh, J. P. and R. P. Morgan, "Educational Computer Utilization and Computer-Communications," Memorandum 71/7, (94 pp.), November, 1971. Available as ERIC document number ED 057 575.

12. Niehaus, C. A., "Utilization of Telecommunications by Academic and School Libraries in the United States," Memorandum 72/1, (51 pp.), March 1972. Available as ERIC document number ED 064 901.

13. Anderson, B. and E. Greenberg, "Educational Production Functions for Teacher-Technology Mixes: Problems and Possibilities," Memorandum 72/2, (96 pp.), March, 1972. Available as ERIC document number ED 064 900.

14. Rothenberg, D., "Vocational/Technical Education: Status, Trends and Issues, Related to Electronic Delivery," Memorandum No. 73/1, January, 1973. Available as ERIC document number ED 071 438.

15. Rothenberg, D., "Early Childhood Education: Status, Trends, and Issues Related to Electronic Delivery," Memorandum No. 73/2, (111 pp.), May, 1973. Available as ERIC document number ED 077 217.

16. Rothenberg, D., "Education of the Handicapped: Status, Trends and Issues Related to Electronic Delivery," Memorandum 73/4, (92 pp.), December, 1973. Available as ERIC document number ED 086 235.)

17. Lipman, D., "Technology in the Public Schools?" Memorandum 73/6, (95 pp.), December, 1973. Available as ERIC document number ED 087 463.

18. Robinson, B., "A Delphi Forecast of Technology in Education," M.A. Thesis, Program in Technology and Human Affairs, Washington University, Report No. (R)T-73/1, August, 1973.

19. Demerath, N. J., and L. A. Daniels, "How to Make 'The Fourth Revolution' - Human Factors in the Adoption of Electronic Instructional Aids," Memorandum No. 73/5, (84 pp.), December, 1973. (ERIC ED 086 262)

19A. Wong, M., "The Role of Technology in Non-Traditional Higher Education," M.S. Thesis, Program in Technology and Human Affairs, Washington University, August, 1974.

20. Curtis, J. A., "Recommendations for a National Educational Telecommunications Network," paper presented at Conference on Frontiers in Education, Purdue University, 1973. Revised version published in *Engineering Education*, Vol. 64, No. 8, pp. 567-571, May, 1974.

21. Burtt, J. E., et al., "Final Report: Technology Requirements for Post-1985 Communications Satellites," NASA-CR-114680, Lockheed Missiles and Space Co., October, 1973.

22. Simon, K. A. and W. V. Grant, "Digest of Educational Statistics: 1972 Edition," DHEW Publication No. (OE)73-11103, U.S. Government Printing Office, Washington, D.C. 1973.

23. Morgan, R. P. and J. P. Singh, "Satellite Utilization for Educational Communications in the United States," AAS Paper No. 73-150, 19th Annual Meeting, American Astronautical Society, Dallas, Texas, June 19-21, 1973.

24. Foster, B. J., "Statistics of Public Elementary and Secondary Day Schools; Fall 1972," DHEW Publication No. (OE)73-11402, U.S. Government Printing Office, Washington, D.C. 1973.

25. Barr, R. H., "Expenditures and Revenues for Public Elementary and Secondary Education, 1970-71," DHEW Publication No. (OE)73-11407, U. S. Government Printing Office, Washington, D. C. 1973.

26. Denzau, A., "Public Educational Finances: 1949-1985," Memorandum 71/4 (45 pp.), Center for Development Technology, Washington University, St. Louis, November, 1971. Available as ERIC document number ED 057 573.

27. Coleman, J. S. et al., "Equality of Educational Opportunity," U. S. Department of Health, Education and Welfare, Washington, D. C., 1966.

28. Howe, H., "Anatomy of a Revolution," Saturday Review, pp. 84-88, Nov. 20, 1971.

29. Koerner, J., "Educational Technology: Does It Have a Future in the Classroom?" Saturday Review, 1973, 1, No. 4, 43-46.

30. Kohl, H., "The Open Classroom," A New York Review/Vintage Book, 1969.

31. Silberman, C. E., "Crisis in the Classroom," Random House, New York, 1970.

32. National Academy of Engineering, "Application of Technology to Improve Productivity in the Public Service Sector of the National Economy," Summary Report and Recommendations Based on Symposium and Workshops held November 1 and 2, 1971, (1973).

33. "Productivity and Efficiency in Education," A Report by the Education Panel to the Committee on Automation Opportunities in the Service Areas, Federal Council on Science and Technology, December, 1972.

34. Jamison, E., Suppes, P. and S. Wells, "The Effectiveness of Alternative Instructional Media: A Survey," Research Paper No. 110, Graduate School of Business, Stanford University, February, 1973.

35. "Improving Productivity of School Systems Through Educational Technology: Final Report of Symposium August, 1973," Research for Better Schools, Philadelphia.

35A. Jamison, D. and S. Klees, "The Cost of Instructional Radio and Television for Developing Countries," Institute for Communication Research, Stanford University, March, 1973.

36. Grayson, L. P., "Costs, Benefits, Effectiveness: Challenge to Educational Technology," 1972 Science 175, 1216-1222.

37. "Down Sesame Street: A Study of Instructional Technology," The Network Project, Notebook No. 6, p. 44, November, 1973.

38. Smith, R. L., The Wired Nation, New York, Harper Colophon, 1970.

39. Neal, C. B., "A Consumer-Economics View of Proposed CATV Channel Assignment Plans," IEEE Transactions on Broadcast and Television Receivers, 1973.

40. Sloan Commission on Cable Communications, On The Cable, New York, McGraw-Hill, 1971.

41. Federal Communications Commission, "Cable Television Service: Cable Television Relay Service," Federal Register, 37, No. 30, February 12, 1972.

42. Rickel, J. A., "What About Small Systems Caught in the Top 100 Net?," TV Communications, October, 1972.

43. Stetten, K. J. and K. L. Rodney, "A Study of the Technical and Economic Considerations Attendant on the Home Delivery of Instruction and Other Socially Related Services Via Interactive Cable TV; Vol. 1: Introduction and Interim Summary," Report M72-200, The MITRE Corporation, McLean, Virginia, 1973.

44. JCET (Joint Council on Educational Telecommunications) News, Vol. V, No. 4, 1126 Sixteenth Street, N.W., Washington, D.C. 20036, April, 1973.

45. Barnett, H. J. and A. T. Denzau, "Future Development of Instructional Television," Memo 71/5, Center for Development Technology, Washington University, November, 1971. (Available as ERIC document No. ED 057 574)

46. Division of Educational Technology, "Schools and Cable Television," National Education Association Report, 1971.

47. Walkmeyer, J., "Planning Alternative Organizational Frameworks for a Large-Scale Educational Telecommunications System Served by Fixed/Broadcast Satellites," Memo 73/3, Center for Development Technology, Washington University, June, 1973.

48. National Education Association, "Man-Made Moons: Satellite Communications for Schools," prepared by L. Grayson, F. W. Norwood and H. E. Wigren, 1972.

49. Umans, S., "How to Cut the Cost of Education," McGraw-Hill, New York, 1973.

50. Charp, S., "Use of Computer in Instruction - A Case Study," in "Improving Productivity of School Systems Through Educational Technology," Research for Better Schools, Philadelphia, August, 1973.

51. Hansen, D. N. et al., "Research and Implementation of Collegiate Instruction of Physics Via Computer-Assisted Instruction," Vol. 1, Computer-Assisted Instruction Center, Florida State University, Tallahassee, 1968.

52. Bitzer, D. and D. Skaperdas, "The Design of an Economically Viable Large-Scale Computer-Based Education System," CERL Report X-5, University of Illinois, Urbana, Illinois, February, 1969.

53. Coleman, J. S., "Education in Modern Society," in Greenberger, M., ed., Computers, Communications, and the Public Interest, Johns Hopkins Press, 1971.

54. Armsey, J. W., and N. C. Dahl, "An Inquiry into the Uses of Instructional Technology," A Ford Foundation Report, 1973.

55. Anastasio, E. J. and J. S. Morgan, "Study of Factors That Have Inhibited a More Widespread Use of Computers in the Instructional Process," 1972, EDUCOM Interuniversity Communications Council.

56. Simon, K. A. and M. M. Frankel, "Projections of Educational Statistics to 1981-1982," 1972 Edition, DHEW Publication No. (OE) 73-11105, U. S. Government Printing Office, Washington, D. C., 1973.

58. "New Students and New Places: Policies for the Future Growth and Development of American Higher Education," Report of the Carnegie Commission on Higher Education, McGraw-Hill Publishing Company, Hightstown, New Jersey, 1971.

59. Willingham, W. W., "Free Access Higher Education," College Entrance Examination Board, New York, 1970.

60. "The Fourth Revolution: Instructional Technology in Higher Education," Report of the Carnegie Commission on Higher Education, McGraw-Hill Publishing Company, Hightstown, New Jersey, 1972.

61. "Report on Higher Education," report of an independent task force funded by the Ford Foundation, F. Newman, Chairman, U. S. Department of Health, Education, and Welfare, U. S. Government Printing Office, Washington, D. C., 1971.

62. Kemeny, J. G., "Man and the Computer," Charles Scribner's Sons, New York, pp. 74-75, 1972.

63. "Diversity by Design," A Report of the Commission on Non-Traditional Study, Jossey-Bass Publishers, San Francisco, 1973.

64. Armsey, J. W. and N. C. Dahl, "An Inquiry into the Uses of Instructional Technology," A Ford Foundation Report, New York, pp. 88-90, 1973.

65. Bowen, H. R., "Financing the External Degree," in Diversity by Design, op. cit.

66. Illich, I., Deschooling Society, Harrow Books, 1972.

67. "Surge," prospectus for 1973-1974, Colorado State University, Fort Collins, Colorado.

68. Martin-Vegue, C. A., et al., "University Instructional Television Networks," in Journal of Educational Technology Systems, Vol. 1, No. 1, pp. 35-56, 1972.

69. Weingarten, F. W., et al., "A Study of Regional Computer Networks," The University of Iowa, 1973.

70. Greenberger, M. W., et al., "Computer and Information Networks," Science, Vol. 182, No. 4107, pp. 29-35, October 5, 1973.

71. Ornstein, S. M., et al., "The Terminal IMP for the ARPA Computer Network," Spring Joint Computer Conference, Atlantic City, New Jersey, May, 1972.

72. "The PEACESAT Project," Department of Speech-Communication, University of Hawaii (undated).

73. Abramson, N., "The ALOHA System - Another Alternative for Computer-Communications," Fall Joint Computer Conference, 1970.

74. Abramson, N. and K. A. Mai, "Pacific Educational Computer Network Study," Summary of Planning and Review Meeting, January 8, 1973.

75. Ling, S., "Alaskan Satellite Seminar," prepared for Research for Better Schools Symposium on Improving Productivity of School Systems Through Educational Technology, August, 1973.

76. Smith, D. D., "Satellite Applications for Education, Culture and Development," UNESCO Report COM/WS.333, 1973.

77. Potter, J. G., and J. M. Janky, "The ATS-F Health-Education Technology Communications System," Proceedings of 1973 International Conference on Communications, Seattle, Washington, June, 1973.

78. Lewis, P., "Educational Satellites: Teaching Technology Looks Up," Nation's Schools, Vol. 92, No. 4, pp. 39-43, October, 1973.

79. Singh, J. P. and D. T. Jamison, "The Satellite Instructional Television Experiment in India: A Case History," A Report prepared for the Academy for Educational Development, Inc., Washington, D.C., (1973)

80. Morgan, R. P. and J. P. Singh, "A Guide to the Literature on Application of Communications Satellites to Educational Development," An ERIC Paper, ERIC Clearinghouse on Media and Technology, Stanford University, Palo Alto, California, April, 1972.

81. Morgan, R. P., and J. P. Singh, "Communications Satellites in Education," prepared for Handbook on Contemporary Education, R. R. Bowker Company, (forthcoming).

82. "Productivity in Higher Education," Educational Technologies Symposium at State University of New York at Stony Brook, Sept. 1973.

83. Hupe, H., "The Economics of a Satellite Delivery System for Open Learning and the Resulting Implications for Subject Matter and Learner Audience," Paper prepared for National Conference on Open Learning in Higher Education, Lincoln, Nebraska, January 16-18, 1974.

84. Hupe, H., "The Role of the Federal Government in Educational Applications of Satellite and Cable - A Normative Discussion," Paper presented at Fourth Annual National Educational Technology Conference, San Francisco, California, March 12-15, 1974.

85. Horley, A. L., "A Commercially Viable 2.5 GHz Educational Satellite Service," Paper prepared for Fifth AIAA Communications Satellite Systems Conference, Los Angeles, California, April 1974.

86. Frankel, M. M. and J. F. Beamer, "Projections of Educational Statistics to 1982-1983," 1973 Edition, DHEW Publication No. (OE) 74-11105, U. S. Dept. of Health, Education and Welfare, 1974.

87. Grant, W. V. and C. G. Lind, "Digest of Educational Statistics," 1973 Edition, DHEW Publication No. (OE) 74-11103, U. S. Dept. of Health, Education and Welfare, 1974.

88. Bernstein, N. N., "Legal Restraints on Dissemination of Instructional Materials by Educational Communications Systems," Memorandum No. 72/5, (33 pp.), Center for Development Technology, Washington University, October, 1972.

89. "Priorities for Action: Final Report of the Carnegie Commission on Higher Education," McGraw-Hill, New York, 1973.

90. Johnson, R. C., "Trends and Developments in Black Higher Education and Their Implications for the Black Community," Special Paper presented to Graduate Institute of Education, Washington University, St. Louis, April, 1974.

91. "A Digest of Reports of the Carnegie Commission on Higher Education," McGraw-Hill, New York, 1974.

92. Morgan, R. P., "Communications Technology in the Future of Higher Education in the United States," Paper prepared at invitation of H. Cassirer for Symposium on Communications Media and the Future of Higher Education, Stuttgart, Germany, Nov. 2-4, 1973.

93. Morris, A. J. et al., "Final Report on Cost Effectiveness of Continuing Engineering Studies by Television," Report prepared for Continuing Engineering Studies Division, American Society of Engineering Education, May, 1974.

94. Zigerell, J. J. and H. M. Chausow, "Chicago's TV College - A Fifth Report," Learning Resources Laboratory of the City Colleges of Chicago, January, 1974.

95. Hawkridge, D., "A Summary of the Instructional System Used by the Open University in Great Britain in 1971," Institute of Educational Technology, Bletchley, England, (1971). (Available as ERIC #062 605.)

96. "Proceedings of First Annual National Conference on Open Learning in Higher Education," Lincoln, Nebraska, January 16-18, 1974.

97. Eaton, D. and A. R. Gibbons, "S-U-N: Rising in the Midwest," in American Education, pp. 35-36, Dept. of Health, Education and Welfare, March, 1974.

98. "Five Universities Join in Regional Program," St. Louis Post-Dispatch article, July 21, 1974.

99. Levien, R. E., "The Emerging Technology: Instructional Uses of the Computer in Higher Education," McGraw-Hill, 1972.

100. Comstock, G. A., in "The Emerging Technology: Instructional Uses of the Computer in Higher Education," Chapter 7, McGraw-Hill, 1972.

101. Kerr, C. A., in Levien, R. E., "The Emerging Technology: Instructional Uses of the Computer in Higher Education," p. xvi, McGraw-Hill, 1972.

102. Bondeson, C. V., remarks at Conference on Productivity in Higher Education, State University of New York, Sept., 1973. See also "The TICCET Project: Design Strategy for Educational Innovation" in Conference Proceedings, pp. 84-104.

103. Ah Mai, Karen, "Pacific Educational Computer Network Study: Results of the Second Planning and Review Meeting," Tech. Report CN74-33, The Aloha System, University of Hawaii, May 31, 1974.

104. Ah Mai, Karen, "Survey of Educational Computing in the Pacific Rim," Tech. Report CN74-34, The Aloha System, University of Hawaii, June, 1974.

105. Ah Mai, Karen, "Organizational Alternatives for a Pacific Educational Computer-Communications Network," Tech. Report CN74-27, The Aloha System, University of Hawaii, May, 1974.

106. Goldstein, N. W., "Alternative Television: Status, Trends and Issues," M.A. Thesis, Program in Technology and Human Affairs, Washington University, St. Louis, May, 1974.

107. "New York State Library Will Operate Nationwide Fax Network, Linked to Satellite," in Cable Libraries, (Newsletter), Vol. 2, No. 4, pp. 6-7, June, 1974.

108. Bailey, L. I. and R. Stadt, "Career Education: New Approaches to Human Development," McKnight Publ., 1973.

109. Worthington, R. M., in Ref. 108, p. 270.

110. Belitsky, A. H., "Private Vocational Schools: Their Emerging Role in Post-Secondary Education," in Trends in Post-Secondary Education, Office of Education, Dept. of HEW, Washington, D. C., 1970.

111. Remarks by A. M. Suchesk at Session entitled "Media in Vocational Education/Background Notes of Projects on this Session," (mimeo), Industrial Training and Education Division, Association of Education and Communications Technology, (undated).

112. Pine, P., "Shared Services and Cooperatives: Schools Combine Resources to Improve Education," National School Public Relations Association, Washington, D. C., p. 34, 1971.

113. Aerospace Education Foundation, Vocational Instruction Systems of the Air Force Applied to Civilian Education, Praeger Publ., New York, 1971.

113A. "Computer-Based Vocational Guidance Systems," U. S. Office of Education Report OE-25053, 1969.

114. "Computerized Vocational Information System," Pamphlet. (Undated).

115. Katz, M. et al., "SIGI - A Computer-Based Aid to Career Decision-Making," EDUCOM, 7, No. 2, pp. 12-17, 1972.

116. Axford, R. W., "Adult Education: The Open Door," International Textbook Co., 1969.

117. Griffiths, W. S. and A. P. Hayes, eds., "Adult Basic Education: The State of the Art", U. S. Government Printing Office, March, 1970.

118. "Annual Report of the U. S. Commissioner of Education: Fiscal Year 1972," U. S. Government Printing Office, 1973.

119. Okes, I. E., "Participation in Adult Education, Initial Report," National Center for Educational Statistics, Office of Education, U. S. Government Printing Office, 1971.

120. "Illiteracy in Children Found High," St. Louis Post-Dispatch news article, May 5, 1974.

121. "Noncredit Activities in Institutions of Higher Education, Registrations 1967-1968," National Center for Educational Statistics, 1972.

122. Osso, N. A., "Adult Basic Education Program Statistics: Students and Staff Data July 1, 1971 - June 30, 1972 and Selected Summaries of Fiscal Years 1968-1972," DHEW Publ. No. (OE) 74-11413, Government Printing Office, 1974.

123. Louis Harris and Associates, Inc., Survival Literary Study, Conducted for the National Reading Council, Sept., 1970.

124. Liveright, A. A. and D. L. Mosconi, "Continuing Education in the United States: A New Survey," prepared by the Academy for Educational Development for N.I.H., Washington, D. C., March. 1971.

125. "RFD Overview," Pamphlet.

126. "RFD Newsletter," Sept. 1971; March, 1972.

127. Conversation by D. Rothenberg with B. Frank, Project Director for "American Pie Forum," August 13, 1974.

128. National Foundation for the Improvement of Education, "The Improvement of Literacy," Report prepared for American Revolution Bicentennial Commission, Sept. 1, 1973.

128A. Conversation by D. Rothenberg with B. Wilson, Associate Director of Programming for KET, August 13, 1974.

129. "Summary of Project STRIVE", April 15, 1972, (mimeo).

130. William E. Hopke, (Editor), Encyclopedia of Careers and Vocational Guidance, Volume II. Chicago: J. G. Ferguson Publishing Co., 1972.

131. Occupational Outlook Handbook, 1972-73 Edition, Bureau of Labor Statistics, Department of Labor, Washington, D. C.

132. Health Resources Statistics. Health Manpower and Health Facilities, 1972-73, National Center for Health Statistics, Health Services and Mental Health Administration, Public Health Service, Department of Health, Education, and Welfare, Washington, D. C. (1973).

133. Statistical Abstract of the United States: 1973, United States Bureau of the Census, Department of Commerce, Washington, D. C. (1973).

134. Institute of Public Policy Analysis, Stanford University, Teleconferencing: Cost Optimization and Ground Systems for Continuing Professional Education and Medical Services, Stanford, California: Stanford University, 1972.

135. Lionel V. Baldwin, Videotape Applications in Engineering Education, Paper presented at the Symposium on Educational Technologies: Productivity in Higher Education, Stony Brook, New York, Sept. 1973.

136. John D. Alden, "Opportunities for Engineering Graduates, 1974-1984," in Engineering Education, 64, No. 7, (April, 1974).

137. Department of Continuing Medical Education, American Medical Association, "Survey of Medical Education Activities: State Medical and Medical Specialty Societies, 1972." Chicago: American Medical Association, 1974. (mimeo)

138. Davis B. McCarn and Joseph Leiter, "On-Line Services in Medicine and Beyond," in Science, 181, July 27, 1973. "Non-United States Centers," "Medline Network Participants, January, 1974," and "Federal Medline Users." (mimeos) "Medline," "Public Health Service, National Institutes of Health, Department of Health, Education, and Welfare, Washington, D. C. (March, 1974).

139. Merp Memo, Indianapolis: Medical Education Resources Program, 3, No. 2, November, 1973. "Army Medical Center Tapes Added to Networks," Ibid.

140. Program of the International Seminar on "Recent Advances in Psychotherapeutic Drugs," January 17, 1973.

141. Aileen Alt Powell, "'Bird' of Learning, Health: Big Satellite to Fly Soon," The Milwaukee Journal, February 19, 1974.

142. Suilin Ling, "Alaskan Satellite Seminar. A Case History of Providing Teachers In-Service Training in Remote Rural Areas Via New Telecommunications Technology - A Prototype," Paper presented at the Research for Better School Symposium for Improving Productivity of School Systems Through Educational Technology, Philadelphia, Pennsylvania, August, 1973.

143. Ausness, C. and B. Bowling, An Experiment in Educational Technology: An Overview of the Appalachian Education Satellite Project. Lexington, Kentucky: Resource Coordinating Center, University of Kentucky, Tech. Report No. 2, March, 1974.

144. National Institute of Education, Department of Health, Education and Welfare, "Analysis and Assessment of Educational Satellite Communications Demonstration," RFP NE-R-74-0002, November 8, 1973.

145. Philip Lewis, "Satellites: Teaching Technology Looks Up," in Nation's Schools, 92, No. 4, pp. 39-43, (October, 1973).

146. Practising Law Institute, "Main Topics" and "AALS Presentation." (mimeos). Letter from Henry W. Enberg II dated March 11, 1974.

147. Joint Committee on Continuing Legal Education of the American Law Institute and the American Bar Association, "ALI-ABA CLE-TV Spring Semester," "Schedule of Modern Real Estate Transaction Series on ALI-ABA CLE-TV," "Schedule of Federal Taxation Series on ALI-ABA CLE-TV," and "Schedule of Programs in Supreme Court Series on CLE-TV." (mimeos)

148. Alfred C. Ingersoll and Ricardo Gonzales, Jr., "UCLA Professional Certificate Program in Engineering Management for Public Works," in *Engineering Issues*, 100, No. EI 1, (January, 1974).

149. Richard Adler and Robert Hind, *The Cable and Continuing Education*, Palo Alto, California: Aspen Workshop on Uses of the Cable, Aspen Program on Communications and Society, 1973.

150. Conversation with Dr. Jane Richards, Executive Director, Indiana Higher Education Telecommunications System, August 8, 1974.

151. John J. Archibald, "Cartoons with a Message," *St. Louis Post-Dispatch*, April 18, 1972.

152. Beatrice Berg, "Maureen 'Talks' to Children Who Watch but Cannot Hear," *New York Times*, July 9, 1972.

153. Jerome D. Schein, et al., "Television for Deaf Audiences: A Summary of the Current Status," Deafness Research Training Center, New York University School of Education (April, 1972).

154. Herbert Kupferberg, "What *You* Think of Children's TV," *Parade*, March 4, 1973.

155. Samuel Ball and Gerry Ann Bogatz, *First Year of "Sesame Street": An Evaluation*, Princeton, Educational Testing Service, 1970.

156. Gerry Ann Bogatz and Samuel Ball, *The Second Year of "Sesame Street": A Continuing Evaluation*, Volumes I and II. Princeton: Educational Testing Service, 1971.

157. Ellen Searcy and Judith Chapman, *The Status of Research in Children's Television,* A Report prepared for the Interagency Panel on Early Childhood Research and Development, Washington, D. C.: Social Research Group, The George Washington University, 1973.

158. Office of Program Development, Community Education Services Division, Children's Television Workshop, *The Neighborhood Youth Corps/Children's Television Workshop Summer Project 1972 Report on Operations and Project Monitoring*, New York: Children's Television Workshop, 1972.

159. "Regional Focus for Field Operations," *Children's Television Workshop Newsletter*, No. 28, March 30, 1973."

160. "A Report on Our Appalachian Project," *Scope*, July, 1972 (mimeo).

161. "Educational Technology: A Vote of Confidence," in *EDUCOM*, *7*, No. 2, (Summer, 1972).

162. The International Council for Educational Development, *Instructional Broadcasting: A Design for the Future*, *A Report Prepared for the Corporation for Public Broadcasting*, January, 1971.

163. "Careers in Early Childhood Education," *Children's Television Workshop Newsletter*, No. 27, February 1, 1973.

164. "Summary Evaluation Report of the Appalachia Preschool Education Program," Charleston, West Virginia: Appalachia Educational Laboratory, Inc., 1971.

165. Lanny E. Morreau, "Teaching Your Child," Minneapolis: CEMREL, Inc., 1972. Letter from Mr. Morreau to D. Rothenberg dated August 23, 1972, remarks of Mr. Morreau during phone conversation with D. Rothenberg August 9, 1972.

166. *Preprimary Enrollment Trends of Children Under Six*, National Center for Educational Statistics, Office of Education, U. S. Department of Health, Education and Welfare, Washington, D. C. (1970).

167. *Preprimary Enrollment, October, 1970*, National Center for Educational Statistics, Office of Education, U. S. Department of Health, Education, and Welfare, Washington, D. C. (1971).

168. The Education Commission of the States Task Force on Early Childhood Education, *Early Childhood Development Alternatives for Program Implementation in the States*, Denver: Education Commission of the States, 1971.

169. "Handicapped Children in the United States and Special Education Personnel Required, (Estimated) 1971-1972," prepared by the Bureau of Education for the Handicapped, Office of Education, U. S. Department of Health, Education and Welfare, Washington, D. C., (October, 1971), (mimeo).

170. John C. Belland, "The National Center of Educational Media and Materials for the Handicapped," *Audiovisual Instruction*, February, 1973.

171. Samuel M. Genensky et al., *Advances in Closed Circuit TV Systems for the Partially Sighted*, Santa Monica, California: Rand Corporation, April, 1972.

172. Remarks of Rex A. Carr, Director of Instruction, Shawnee Mission School District (Kansas), during phone conversation May 24, 1973, with D. Rothenberg.

173. John E. D. Ball, "Television for the Deaf," Washington, D. C., Public Broadcasting Service, October 31, 1972, in ERIC ED 070 266, and telephone conversation with Mr. Ball, December 6, 1973, with D. Rothenberg.

174. J. D. Fletcher et al., "Computer-Assisted Instruction for the Deaf at Stanford University, Annual Report," Palo Alto, California Institute for Mathematical Studies in Social Science, January, 1973, in ERIC ED 072 641.

175. Edward M. Dickson and Raymond Bowers, The Video Telephone: A New Era in Telecommunications, A Technology Assessment prepared by the Program on Science, Technology, and Society, Ithaca, N. Y.: Cornell University, June, 1973.

176. Goldmark, P. C., "Communications for a New Rural Society," Journal of the SMPTE, July, 1972.

177. Sundquist, J. L., "Europe Stops the Urban Swarm," The Nation, Vol. 219, No. 2, pp. 39-42, July 20, 1974.

178. Morrison, P., "Population Distribution Policy: Issues and Objectives," RAND Paper P-4793, Santa Monica, May, 1972.

179. Perrine, J., "Telecommunications and Rural Education," M.A. Thesis, Program in Technology and Human Affairs, Washington University, St. Louis, March, 1975.

180. Developed by Walkmeyer (see Ref. 47), based upon PBS extrapolations from 1970 Census data and Louis Harris and Associates survey.

181. "Comments of the Corporation for Public Broadcasting and the Public Broadcasting Service in Response to the Commission's Report and Order of March 20, 1970, in the Matter of the Establishment of Domestic Communications Satellite Facilities by Non-Governmental Entities, F.C.C. Docket No. 16495, May 12, 1971.

182. JCET News, Vol. 4, No. 11, November, 1972.

183. 1970 Census: Subject Report; Education Attainment.

184. Lenore Epstein, "Migrant Farm Workers," Social Security Administration Bulletin, XXVI, 1963.

185. Consulting Services Corporation, "Migrant Farm Workers in the State of Washington," Seattle, Washington, 1966.

186. Michigan Employment Security Commission, 1970 Farm Labor & Rural Manpower Report.

187. Consulting Services Corporation, Seasonal Farm Workers in the State of New Jersey, Seattle, Washington, 1968.

188. Texas Good Neighbor Commission, 1970 Farm Labor Report.

189. U. S. Dept. of Agriculture, Hired Farm Working Force of 1971.

190. E. John Kleinert, et al., Migrant Children in Florida, Phase II Report of the Florida Migratory Child Survey Project, 1968-1969, Miami University, Coral Gables, Florida, August, 1969.

191. U. S. Department of Health, Education and Welfare, Children at the Crossroad, 1970, Office of Education.

192. Delaware Dept. of Public Instruction, Vocational/Technical Division, A Demographic Study of Farm Migrants in Delaware, LaVerne, B., and Maurice E. Thomasson, Dover, Delaware, Sept, 1967.

193. Education Commission of the States, Early Childhood Programs for Migrants: Alternatives for the States, Denver, Colorado, May, 1972.

194. U. S. Department of Health, Education and Welfare, Children at the Crossroad, 1970. Office of Education. Exact amount was $51,014,319.00.

195. Personal communication to J. Perrine by W. Miller, Administrator, Migrant Student Record Transfer System, Little Rock, Arkansas, 1973.

196. Fuchs, E. and R. Havinghurst, To Live on this Earth, Doubleday & Co., New York, 1972.

197. Fuchs, E., "American Indians at School: Time to Redeem an Old Promise," Saturday Review, January 24, 1970.

198. Bureau of Indian Affairs (BIA) Statistics Concerning Indian Education, FY 1972.

199. "We the Black Americans," Bureau of the Census, U. S. Dept. of Commerce, Washington, D. C., July, 1972.

200. Molden, V., "Communications Technology and Black Americans: Utilization, Participation and Impact," M. A. Thesis, Program in Technology and Human Affairs, Washington University, St. Louis, Missouri 63130, (forthcoming).

201. Johnson, R., C. III, "Telecommunications and the Socialization of Black Americans: Issues, Concerns and Possibilities," M. A. Thesis, Program in Technology and Human Affairs, Washington University, St. Louis, Missouri 63130, August, 1974.

202. Ball, S. and G. A. Bogatz, "A Summary of the Major Findings from Reading with Television: An Evaluation of the Electric Company," Educational Testing Service, Princeton, New Jersey, March, 1973.

203. Jamison, D., Suppes, P., and S. Wells, "The Effectiveness of Alternative Instructional Media: A Survey," Review of Educational Research, Vol. 44, No. 1, pp. 1-69, 1974.

204. "Census Bureau Unveils Revised Count on U. S. Spanish Speaking," Agenda, National Council of La Raza, Vol. IV, No. 3, March, 1974.

205. Stoddard, E. R., Mexican Americans, Random House, New York, 1973.

206. "Communications Technology for Education, Health-Care Delivery in Appalachia," Center for Development Technology, July, 1972. Report consists of three parts:

    a) Morgan, R. P., Singh, J. P., and C. A. Niehaus, "Educational Telecommunications in Applachia," Phase I Report to the Appalachian Regional Commission, May, 1972, (150 pp), (with assistance from H. Jackoway and J. Itzikowitz).

    b) Singh, J. P. and R. P. Morgan, "Identification of Fixed/Broadcast Satellite-Based Educational and Health Telecommunications Services for the Appalachian Region," Phase II Report to the Appalachian Regional Commission, June, 1972, (135 pp.).

    c) Singh, J. P. and R. P. Morgan, "Identification of Tele-Education/Medicine Experiments for the ATS-F Satellite for the Appalachian Region," Phase III Report to the Appalachian Regional Commission, June, 1972, (34 pp), (with assistance from T. Stagl).

207. Donald N. Rothblatt, Regional Planning: The Appalachian Experience, Heath Lexington Books, Lexington, Massachusetts (1971).

208. A Summary Economic Report of the Appalachian Region, Appalachian Regional Commission, Washington, D. C. (1971).

209. The Appalachian Regional Commission Annual Report 1969, Appalachian Regional Commission, Washington, D. C. (1970).

210. Interim Report, Education Advisory Committee, Appalachian Regional Commission, Washington, D. C. (undated).

211. Appalachia - Education for Tomorrow. Summary and Recommendations, Appalachian Regional Commission, Washington, D. C. (March 1971).

212. Digest of Educational Statistics, 1967, U. S. Office of Education, Washington, D. C. (1968).

213. The Status of Secondary Vocational Education in Appalachia, Research Report No. 10, Appalachian Regional Commission, Washington, D. C., (October 1968).

214. Information distributed at tha ARC Educational Telecommunications Advisory Task Force meeting, Applachian Regional Commission, Washington, D. C. (November 17, 1971).

215. Estimates of United States Television Households, American Research Bureau, Washington, D. C. (1971).

216. "CATV and Station Coverage Atlas with 35-Mile Zone Maps (1971-1972)," Television Digest, Inc., Washington, D. C., 1971.

217. "Health-Education Telecommunications Experiment (HET): Experiment Summary Description," Nov. 1, 1973.

218. "Educational Technology Demonstration: Report and Proposal," Federation of Rocky Mountain States, July 28, 1972.

219. Lew, W., NASA, personal communication with R. P. Morgan, August, 1974.

220. Wigren, H., "Alaska Educational Satellite Project, Proposed Far West Teacher Education Experiment on ATS-G, and Pan Pacific Educational Satellite Network," in *Proceedings of International Colloquium on Educational Satellites*, pp. 89-105, held in Nice, France, May, 1971.

221. "A Study of the Potential of Telecommunications and Educational Technology to Satisfy the Educational Needs of the State of Alaska," Teleconsult, Inc., 2814 Pennsylvania Ave., N.W., Washington, D.C. 20007, May, 1972.

222. *Statistical Abstract of the United States: 1972*, U. S. Bureau of the Census, U. S. Department of Commerce, Washington, D. C. (1972).

223. The United States Senate Special Committee on Aging, *Developments in Aging: 1971 and January-March, 1972*, Washington, D. C., 1972.

224. *1970 Census of Population, General Population Characteristics, United States Summary*, U. S. Bureau of the Census, U. S. Department of Commerce, Washington, D. C. (1972).

225. Margaret Fisk, Editor, *National Organizations of the United States, Volume 1*, Detroit: Gale Research Company, 1973.

226. Claire Townsend, et al., *Old Age: The Last Segregation*, New York: Bantam Books, 1970.

227. Reich, J., "Telemedicine: Assessment of an Evolving Health Care Technology," M.S. Thesis, Program in Technology and Human Affairs, Washington University, St. Louis, August, 1974.

228. Robert Taggart III, *The Prison of Unemployment*, Baltimore: The Johns Hopkins University Press, 1972.

229. *Education and Training Annual Report, CY 1971*, Bureau of Prisons, U. S. Department of Justice.

230. *1970 National Jail Census*, National Criminal Justice Information and Statistics Service, Law Enforcement Assistance Administration, U. S. Department of Justice, Washington, D. C. (1971).

231. *National Prisoner Statistics, State Prisoners, 1970*.

232. *The Budget of the United States Government, Fiscal Year 1974,* Washington, D. C., U.S. Government Printing Office, 1973.

233. "Overview of Education and Training for Fiscal Year 1972," January, 1973, Mimeo.

234. "Project Newgate, College of Social Professions," University of Kentucky, Lexington, Kentucky (pamphlet).

235. "Staff Training Centers," Bureau of Prisons, U. S. Department of Justice, (pamphlet).

236. "Correctional Education: A Bibliography," Federal Bureau of Prisons, February, 1972, (Mimeo).

237. Korman, F., "Innovations in Telecommunications Technology: Implications for Education," Report of the Center for Communication Research, University of Texas, Austin, October, 1971.

238. Commission on Instructional Technology, "To Improve Learning: A Report to the President and the Congress of the United States," Commitee on Education and Labor, House of Representatives, U. S. Government Printing Office, 1970.

239. *Public Television - A Program for Action*, The Carnegie Commission on Educational Television, Bantam Books, New York, 1967.

240. "Comments by the Corporation for Public Broadcasting and the Public Broadcasting Service," Docket 16495, Federal Communications Commission, Washington, D. C., May 12, 1971.

241. "Public Television Moves Toward Development of Station-Funded Market Plan," *JCET News*, Vol. VI, No. 3, pp. 8-10, March, 1974.

242. "Instructional Broadcasting: A Design for the Future," Report by International Council for Educational Development prepared for CPB, Washington, D. C., January 15, 1971.

243. Dysinger, J. H., et al., "An Investigation of Network Television Distribution Systems - Vols. I & II," Prepared for Public Broadcasting Service by the General Electric Company, Philadelphia, Pennsylvania, February, 1971.

244. "Public Television Bill Needs More Work," *JCET News*, Vol. III, No. 9, p. 1-5, September, 1971.

245. "Regional Meetings in U. S. and Canada Called by Agency for Instructional TV," *JCET News*, Vol. V, No. 9, p. 12, September, 1973.

246. "One Week of Educational Television - 1970," by the National Instructional Television Center, Bloomington, Indiana.

247. From School Staffing Survey, HEW, Bulletin No. 7, February 9, 1971.

248. National Education Association, "ITFS - Instructional Television Fixed Service (2500 Megahertz)," Washington, D. C., 1967.

249. Pressman, I., "Computer-Assisted Instruction - A Survey," IEEE Transactions on Education, Vol. #-13, No. 3, September, 1970.

250. Schoen, H. L., "CAI Development and Good Educational Practice," Educational Technology, pp. 54-56, April, 1974.

251. Alpert, D., and Bitzer, D. L., "Advances in Computer-Based Education - A Progress Report on the Plato Program," CERL Report X-10, Coordinated Sciences Lab., University of Illinois, Urbana, July, 1969. See also Alpert and Bitzer, Science, Vol. 167, pp. 1582-1590, March 20, 1970.

252. Suppes, P., "The Uses of Computers in Education," in Computers and Computation, W. H. Freeman Co., San Francisco, 1971.

253. Atkinson, R. C. and H. A. Wilson, "Computer-Assisted Instruction," in Science, Vol. 162, pp. 73-77, October 4, 1968.

254. "The Use of Computers in Instruction," NEA Research Bulletin, pp. 3-4, March, 1971.

255. Feldhausen, J. H. and Lorton, Jr.,P., "A Position Paper on CAI Research and Development," Paper from ERIC, Stanford University, Stanford, California, CED 036 204, February, 1970.

256. Lekan, H. A., Ed., "Index to Computer-Assisted Instruction," Instructional Media Lab., University of Wisconsin, Milwaukee, February, 1970.

257. Jamison, D., et al., "Estimated Costs of Computer-Aided Instruction for Compensatory Education in Urban Areas," Educational Technology, Vol. 10, pp. 49-57, September, 1970.

258. Gelman, M., "Centralized vs. Decentralized Computer-Assisted Instruction Systems," in Proceedings of Spring Joint Computer Conference, AFIPS, 1967.

259. Nuthman, C. F., "On the Feasibility of a 10,000 Terminal Time-Shared Interactive Computer Controlled Educational Television (TICCET) System," Report No. MTP-317 (Rev. 3), The Mitre Corporation, Washington, D. C., May, 1969.

260. Jamison, D., et al., "Communication Economics of Interactive Instruction for Rural Areas," Unpublished Paper, Stanford University, Stanford, California, March, 1971.

261. Darby, Jr., C. A., et al., "Survey of Computing Activities in Secondary Schools," American Institute for Research, Washington, D. C., October, 1970.

262. Levien, R. E., et al., "The Emerging Technology: Instructional Uses of Computers in Higher Education," Report R-503-CCOM/NSF/RC, The Rand Corporation, Santa Monica, California, 1971.

263. Coleman, J. S., and Korweit, N. L., "Multi-Level Information Systems in Education," Paper P-4377, The Rand Corporation, Santa Monica, California, June, 1970.

264. Irwin, M. R., "The Computer Utility," Datamation, p. 23, November, 1966.

265. Kolker, R. J., et al., "Time-Sharing Services," Modern Data, January, 1971 and June, 1971.

266. Weeg, G. P., "The Role of Regional Computer Networks," in Ref. 262.

267. Freeman, D. N. and Pearson, R. R., "Efficiency vs. Responsiveness in a Multiple Service Computer Facility," Proceedings of 1968 ACM Conference, 1968.

268. Brooks, F. P., et. al., "Organizational, Financial, and Political Aspects of a Three-University Computing Center," Proceedings of the 1968 IFIP Congress, 1968.

269. Bhushan, A. K., "Guidelines for Minicomputer Selection," Computer Design, April, 1971.

270. Levien, R. E., "Instructional Uses of the Computer in Higher Education," Paper P-4600, The Rand Corporation, Santa Monica, California, March, 1971.

271. Baran, P., et al., "On Distributed Communications," (in eight volumes), Rand Corporation Reports, August, 1964.

272. Lesser, R. C. and A. Ralston, "The Development of a Multi-Campus Regional Computing Center," Information Processing, 1968, Proceedings of the 1968 IFIP Congress, North-Holland Publishing Co., Amsterdam, 1969.

273. Bhushan, A. K., et al., "Recommendations for an Inter-Computer Communication Network for MIT," Project MAC Memorandum MAC M 355, MIT, Cambridge, Mass., July, 1967.

274. Roberts, L. G., and Wessler, B. D., "Computer Network Development to Achieve Resource Sharing," Spring Joint Computer Conference 1970 Proceedings.

275. Rutledge, R. M., Varian, L. C., et al., "An Interactive Network of Time-Sharing Computers," Carnegie-Mellon University, Pittsburgh, Pennsylvania, 1970.

276. Alt, Franz L., "Data Banks in the Physical Sciences and Engineering," in *The Computer Utility: Implications for Higher Education*, Heath Lexington Books, Lexington, Mass., 1970.

277. Zeidler, H. M., et al., "Patterns of Technology in Data Processing and Data Communications," Stanford Research Institute, Report 7379B-4, Menlo Park, California, February, 1969.

278. Dunn, D. A., "Policy Issues Presented by the Interdependence of Computer and Communications Services," Report 7379B-1, Stanford Research Institute, Menlo Park, California, February, 1969.

279. Bystrom, John W., "Telecommunications Networks for Libraries and Information Systems: Approaches to Development," prepared for the National Conference on Interlibrary Communications and Information Networks (CICIN), sponsored by the American Library Association, Airlie House, Warrenton, Va., Sept. 28-Oct. 2, 1970.

280. *Cable Libraries*, Vol. 2, No. 3, p. 2, May, 1974.

281. Press Release, University of Denver, Public Relations Office, Denver, Colorado, 80210, April 19, 1974.

282. *Cable Libraries*, Vol. 2, No. 4, pp. 6-7, June, 1974.

283. Clayton, J. C., "Information Systems for Educational Policy and Administration," The Rand Corporation, Paper P-4384, Santa Monica, California, June, 1970.

284. Blackwell, F. W., et al., "Educational Information Systems Design - A Conceptual Framework," The Rand Corporation, Paper P-4411, Santa Monica, California, August, 1970.

285. Bushnell, D., and R. L. Howe, "A Report of an Experiment - The State Pilot Project in Educational Data Processing," Department of Education, State of California, May 20, 1964.

286. Arthur D. Little, Inc., *An Analysis of Regional Planning Agencies in California Funded by ESEA Title III: A Study of the Regional Data Processing Centers*, Vol. 3, 1968.

287. Lieberman, D. and Morgan, R. P., "Privacy Impacts of Educational Telecommunications and Information Systems," Memorandum, Center for Development Technology, Washington University, St. Louis, (forthcoming).

288. Sedlacek, W. C., et al., "Summary Report: Information Transfer Systems Requirement Study," Lockheed Missile and Space Company, Report NASA-CR-73421, Sunnyvale, Ca., March, 1970.

289. Burtt, J. E., et al., "Final Report: Technology Requirements for Communications Satellites in the 1980's," Prepared by Lockheed Missile and Space Co. for NASA Ames Research Center, Sunnyvale, Ca., Sept., 1973.

290. Doyle, F., and D. Goodwill, "An Exploration of the Future of Educational Technology," Bell-Canada Report, 1971.

291. National Academy of Engineering, Committee on Public Engineering Policy, A Study of Technology Assessment, prepared for the Committee on Science and Astronautics, U. S. House of Representatives, Washington, D. C., July, 1969.

292. Robinson, B. E. and R. P. Morgan, "A Delphi Forecast of Technology in Education With Implications for Educational Satellite Development," Paper prepared for 4th National Educational Technology Conference, San Francisco, Ca., March, 1974.

293. Ayres, R. U., Technological Forecasting and Long-Range Planning, McGraw-Hill Book Co., New York, 1969.

294. Jantsch, E., Technological Forecasting in Perspective, John Wiley and Sons, New York, 1972.

295. Forrester, J. W., World Dynamics, Wright-Allen Press, Cambridge, Mass., 1971.

296. Meadows, D. H., et al., The Limits to Growth, Universe Books, New York, 1972.

297. Martino, J. P., Technological Forecasting for Decisionmaking, American Elsevier Publishing Co., New York, 1972.

298. Helmer, O., Social Technology, Basic Books, New York, 1966.

299. Polcyn, K. A., "An Educator's Guide to Communication Satellite Technology," Academy for Educational Development, Washington, D.C., Sept., 1973.

300. McNickle, D., "The Indian Tribes of the United States," Oxford University Press, London, 1968.

301. Nelkin, D., "Methadone Maintenance: A Technological Fix," George Braziller, New York, 1973.

302. "Basic Education Rights for the Hearing Impaired," DHEW Publication No. (OE) 73-24001, June 30, 1973.

303. "Basic Education Rights for the Handicapped," DHEW Publication.

304. McLure, W. P. and A. M. Pence, "Early Childhood and Basic Elementary and Secondary Education: Needs Programs, Demands, Costs," National Educational Finance Project, Special Study No. 1, Bureau of Educational Research, College of Education, University of Illinois at Urbana - Champaign, 1970. This monograph is one of a series focussing on several educational subsectors. Although pertinent to our efforts, these reports were discovered too late to be factored into the analysis.

305. Hupe, H. H., "Markets for a Social Services Satellite," Astronautics and Aeronautics, pp. 62-66, February, 1975.

306. Eastwood, Jr., L. F. and R. J. Ballard, "The PLATO-IV System: Where Is It Now? Where Can It Go?", to be Published in Journal of Educational Technology Systems.

307. "Public Service Satellite Consortium Formed," News Release, JCET News, 1126 Sixteenth Street, N.W., Washington, D. C. 20036, January, 1975.

308. Grayson, L. P., "Educational Satellites: The ATS-6 Experiments," The Journal of Educational Technology Systems, November, 1974.

309. Eastwood Jr., L. F. and R. J. Ballard, "Telecommunications Media For the Delivery of Educational Programming," Memo. No. 74/1. Center for Development Technology, Washington University, St. Louis, November, 1974.

310. Hupe, H. H., "Cost-Effectiveness of an Interactive Broadcast Satellite," Astronautics and Aeronautics, pp. 63-67, January, 1975.

311. Morgan, R. P., "A Preliminary Assessment of Potential Impacts of Educational Telecommunications Systems," paper submitted to Special Issue on Social Aspects of Telecommunications, IEEE Transactions on Communications, (forthcoming).